THE Journal

OF THE AMERICAN DENTAL ASSOCIATION

JUNE

1954

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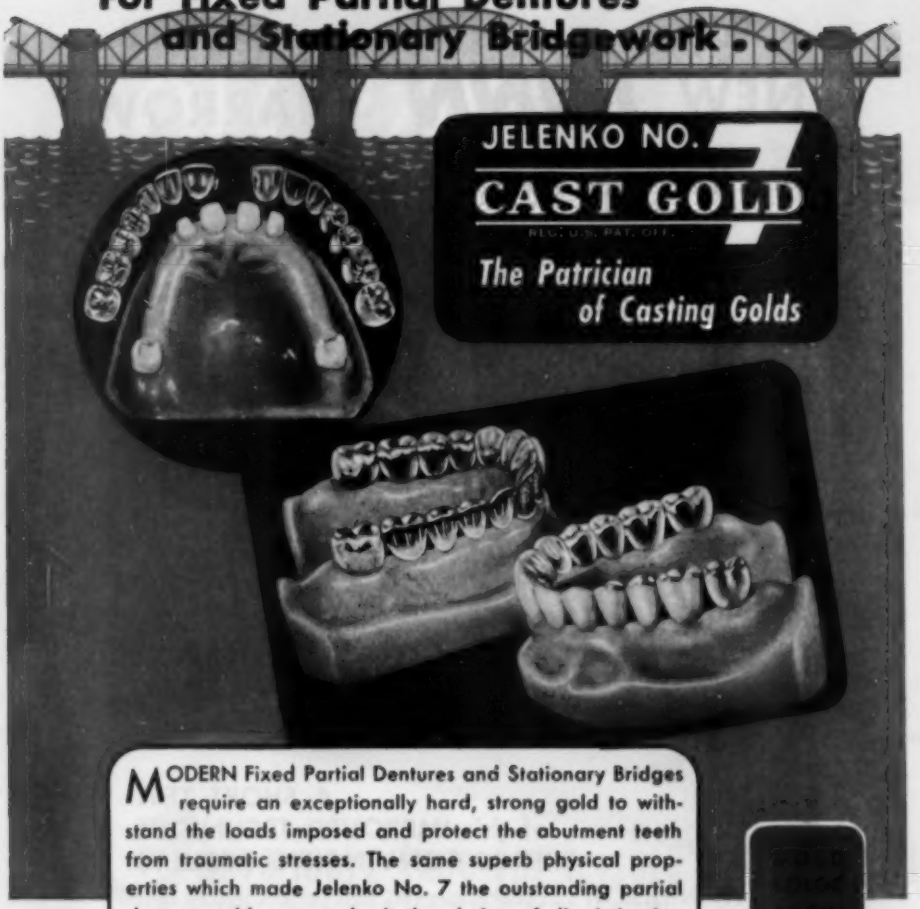

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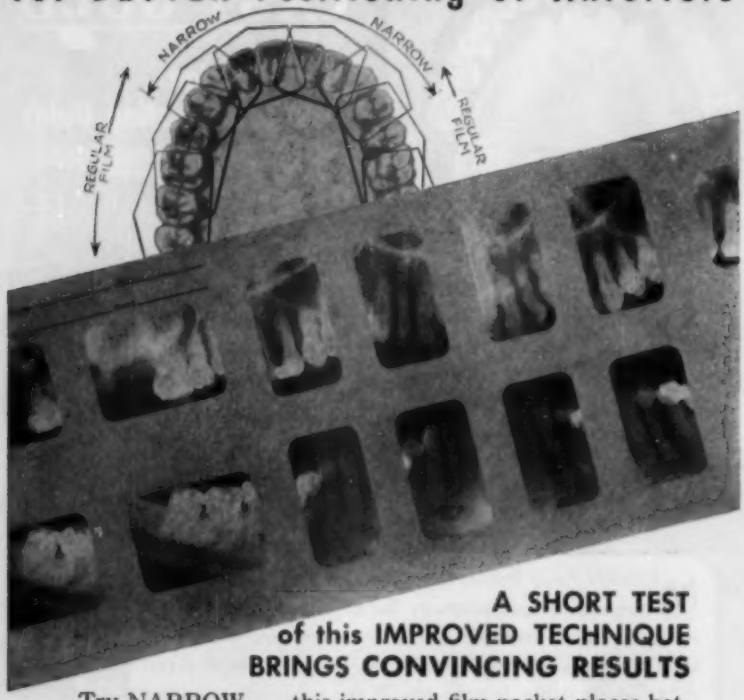

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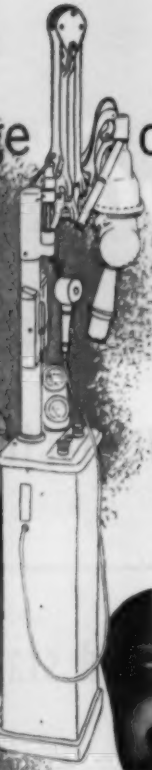

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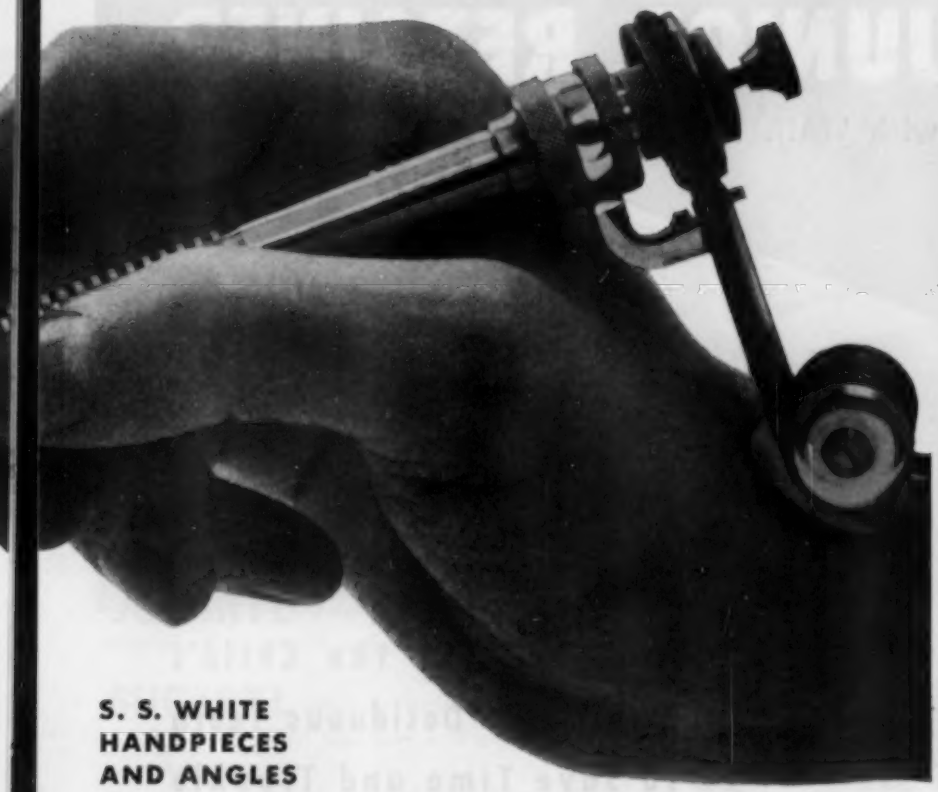

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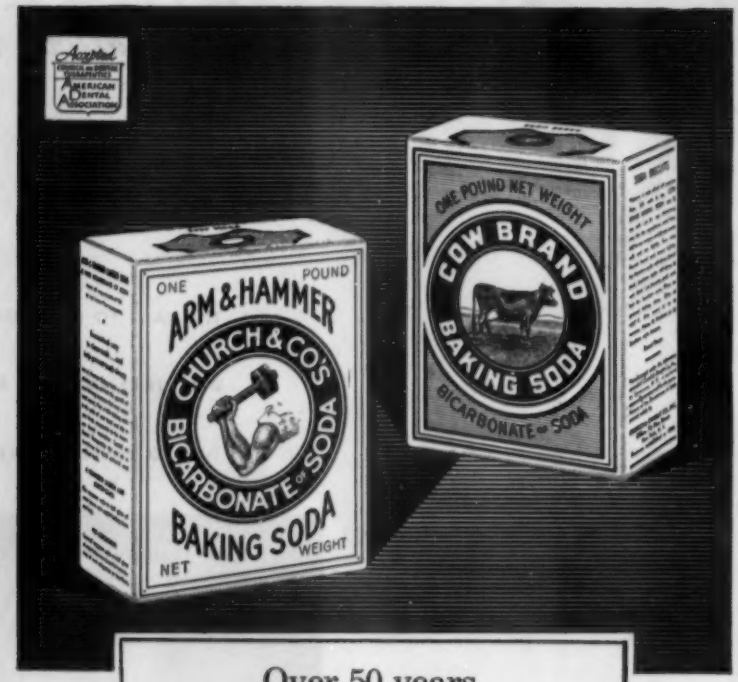

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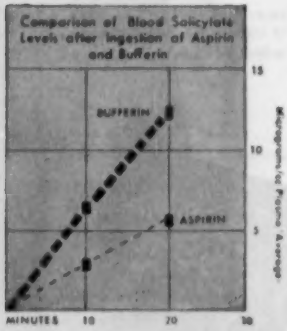

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Management of occlusal problems in the practice of dentistry

The scientific section of this issue of THE JOURNAL is devoted in its entirety to one of the fundamental objectives of dentistry—the attainment of harmonious and functional occlusion. The observation that occlusion is basic in the practice of dentistry at first glance may seem enigmatical, but when full recognition is given to the broader concept of functioning occlusion, its significance becomes graphically clear. As John R. Thompson points out in his contribution to this issue, the scope of occlusion has become so enlarged that it embraces all the integral parts and functions of the dynamic masticating organ. Collectively, these parts are referred to as the stomatognathic system—that system which includes the teeth and their supporting tissues, the mandible and the maxilla proper, the musculature and the two temporomandibular joints, the nerves and the vascular supply, the tongue and certain other indirectly related structures.

Actually, the dentist, whether he is in general practice or in the practice of one of the specialties, must consider two concepts of occlusion.

The first is the anatomical concept, which postulates an ideal arrangement of the teeth, characterized by morphologically correct proximal and occlusal relations and axial inclinations which establish maximum contact of the occluding surfaces. The second, and by far more important, concept postulates physiologic harmonious relations in the functioning of the stomatognathic system, without regard to theoretically correct anatomic relations. Many malocclusions which are anatomically imperfect may be functionally excellent. The reverse condition also often exists.

In order to evaluate abnormal form and function for the purpose of correction, it is necessary to understand normal anatomy, normal growth and normal function of the stomatognathic system. These and other aspects of the problems of occlusion were presented by John R. Thompson, Harry Sicher, Gosta Lindblom, Ernest R. Granger, Henry L. Beyron, Stanley C. Harris and Harold T. Perry at the postgraduate course on "Analysis and Treatment of the Stomatognathic System," Northwestern University Dental School, April 1953. The articles appearing in this issue summarizing the course should serve as an indispensable guide to anyone desirous of extending his knowledge in this field.

Positions and movements of the mandible

Harry Sicher, M.D., D.Sc., Chicago

Despite the great amount of work and the even greater number of publications, some anatomic and functional problems of the temporomandibular joint are still unsolved or controversial. The two most important questions concern the centric position of the mandible and the participation of the various mandibular muscles in the movements of the lower jaw.

It seems that some of the misunderstanding in the discussions on mandibular positions is caused by the lack of a clear and, most important, generally accepted terminology. Therefore, and without prejudice, the following definitions will be used as the basis of this discussion:

1. Rest position of the mandible is the position that the mandible assumes when the mandibular musculature relaxes to tonic contraction; that is, when the body is in upright standing or sitting posture. Any movement of the head and the neck from the upright position forces the mandible out of its rest position. In rest the mandible drops slightly, the incisor teeth are separated by a distance of 2 to 5 mm., the lips are lightly closed. Since muscle tonus under normal and comparable conditions is fairly constant for each individual, the rest position is equally a fairly constant position of the mandible.

2. Occlusal positions are all positions of the mandible in which teeth are in contact. The median occlusal position can be differentiated from right and left lateral, protrusive and retrusive occlusal positions. While there is no difficulty in

Presented in the postgraduate course "Analysis and Treatment of the Stomatognathic System," Chicago, Northwestern University Dental School, April 1, 2 and 3, 1953.

Professor of anatomy and histology, Loyola University Dental School, Chicago. Guest lecturer, Northwestern University Dental School, Chicago.

establishing lateral and protrusive positions, the existence of a retrusive movement from the median occlusal position is denied by some authors. There is no doubt, however, that the overwhelming majority of individuals with a normal and full dentition can execute a retrusive movement of a magnitude varying slightly about 1 mm.

3. Hinge, or terminal hinge, position is the position of the mandible from which the mandibular hinge axis is determined and registered. It is the most retruded position of the mandible that the individual can assume under the action of his mandibular musculature and is, therefore, an unstrained position.

4. Centric position is the physiologic, balanced position of the mandible in which not only the teeth are in normal relation but also the temporomandibular joints and the mandibular musculature are in harmony. It is, therefore, the "ideal" position of the mandible and should, in a normal dentition, coincide with the median occlusal position. The relations of the mandibular condyle to the temporal bone in centric position constitute one of the most important points of controversy. In this article clinical measures where necessity or expediency may play a most important part have not been considered. Clinical success does not prove anything but the acceptability of the method employed; any attempt to prove an anatomical concept by clinical success is merely a rationalization and certainly is not to be regarded as truly scientific evidence.

CENTRIC POSITION

There is one group of clinicians that assumes that centric position coincides with the terminal hinge position and that, therefore, the ideal position of the condyle is the most retruded—or the most retruded unstrained—position of the condyle in the articular fossa. If some definitions add the condition that unstrained lateral movements should be possible from this most retruded position, they are merely redundant. There is no retruded position that the patient can assume from which free lateral movements cannot be made. Of course, followers of this concept must by definition deny any retrusive movement as a normal movement of the mandible. Likewise by definition they cannot accept the possibility of a posterior displacement of the mandible. From theoretical reasons of the biology of joints, it seems improbable that a joint as loose and as freely movable as the temporomandibular joint should be in an extreme or marginal position during normal function, which terminates in median occlusal position. This position would deprive the joint and its ligaments of a range of adaptation or safety which would be expected. This concept would also involve the hardly probable proposition that all individuals with a "perfect" dentition who can execute a retrusive movement suffer from an anterior displacement of the mandible. It must not be forgotten that a retrusive movement is executed by the overwhelming majority of young adults who have a dentition that from all aspects can only be called ideal.

The most important question is that of the method by which proponents of the theory that centric position equals hinge position arrive at their conclusion. Interestingly enough, no attempt has ever been made to examine "normal" individuals with all the armamentarium of anthropologic technic. Instead, this theory has been based on the determination of the hinge axis and the application of these points to clinical practice; and since the clinical results have been satisfactory, it has been concluded that the hinge position of the mandible is its ideal position and that, therefore, centric position is the most retruded position of the lower jaw. The very choice of the word "retruded" instead of "posterior" indi-

cates that there is an awareness, perhaps unconscious, of a retrusion, that is a posterior movement, of the mandible.

The crux of the matter lies in the technic that is employed in the determination of the hinge axis and hinge position. The restricted hinge movement—to an opening of 2 to 4 mm.—that initiates the normal opening of the jaws is evidently too small to allow the registration of the hinge axis. A pure hinge movement of much greater amplitude is necessary for this purpose. It has been stated repeatedly that every person can move the lower jaw in a hinge movement to an opening of one half to three quarters of an inch or occasionally even more. Though this statement is entirely true it is also misleading if one does not add that this movement is an unnatural, forced, learned movement. The normal combination of the rotatory with the sliding component in the opening movement is deeply fixed in the neuromuscular pattern of the mandibular muscles. An effort is required to suppress the forward and downward pull of the external pterygoid muscle by the force of the retrusive or retractive muscle units, that is, mainly the posterior portion of the temporal muscle, perhaps reinforced by the geniohyoid and digastric muscles. It is self-evident that in this attempt these retracting muscles will retrude the mandible as far posteriorly as possible and hold the condyle in this position. No strain occurs in the joint itself during this movement, simply because strain in capsule or ligaments is a powerful inhibitor of muscle action. The initial "strain" that some patients experience during this exercise is strain in the musculature caused by the unaccustomed action; this "strain" soon disappears. For all these reasons the hinge position is in truth the most retruded position of the mandible achieved by the action of the patient's own musculature; but for the same reasons the assumption that the hinge position is the "ideal," the centric position of the mandible is entirely unwarranted and, as a matter of fact, highly improbable.

As "evidence" for this unlikely theory, two observations are adduced in addition to the ever-repeated statement of clinical success. The first argument is based on the fact that a patient whose teeth are ground to conform with the hinge position will have no difficulty in closing into this "new" occlusal relation. Therefore, it is argued, this is clearly his "normal" occlusion, previously disturbed by an anterior displacement of the mandible. This argument is not valid. All muscle activity is governed and regulated by an intricate "feed-back" mechanism. The action of a muscle elicits impulses in the sensory receptors of the muscle itself, its tendon and the capsular ligaments of the joints that the muscle moves. These sensory impulses are "fed back" to the muscle by the reflex arcs and regulate minutely the action of the muscles. They do indeed "aim" muscle action as, for instance, in the movements that are executed if a person with his eyes closed touches the tip of his nose with his index finger. The behavior of the mandibular musculature in this respect is no exception, but it has one more source of "information" of a high complexity and, therefore, of high efficiency; namely, the sensory impulses flowing in from the sum total of the periodontal membranes. Such a singular pattern is set up that its change after occlusal grinding has an immediate and decisive influence in the reflectory regulation of the mandibular musculature. A new neuromuscular pattern is thus established by the new sensory pattern in the periodontal membranes.

A second observation, often quoted as proof that the most retruded position of the mandible is the centric, the ideal position, is the presence of attrition facets that conform to the hinge position and not to the "acquired" median occlusal position of the mandible. This argument also fails to be convincing. It is much more probable that these facets were

ground during retrusive movements in bruxism if, for instance, deep overbite inhibits protrusive and lateral grinding in this nightly exercise.

In summarizing the discussion on the theory that centric position is the most retruded unstrained mandibular position, it can be said that there is no valid evidence in its favor but strong circumstantial evidence against it.

The other school believes that the mandibular condyle is slightly in front of the "most retruded" position in persons with a harmonious occlusion and perfect function. The evidence rests mainly on two observations: the almost constant ability of such individuals to execute a slight retrusive movement from median occlusal position and the tracing of the path of closure between rest and median occlusal positions.

As was mentioned before, the presence of a retrusive movement in "normal" individuals can hardly be regarded as a sign of an anterior displacement and is, therefore, a strong argument in favor of the idea that in centric position, that is, in the ideally balanced position of the mandible, disk and condyle rest against the posterior slope of the articular eminence and that a slight retrusive movement constitutes a "safety margin" during excessive use of masticatory forces.

This theory is further supported by the observation that many patients with disturbances of the temporomandibular joint lack a retrusive movement and therefore suffer from a posterior displacement of the mandible.

The controversy of the two schools extends also to the question of the type of movement between centric and rest positions. While the first school maintains that this movement entails a forward slide, the other states that the movement between these two positions is a hinge movement without, or with a negligible, sliding component. If in centric position the condyle is in the most retruded position, then by definition the mandible slides and rotates into rest position. This movement, however, seems to be contradictory to present knowledge of the muscular mechanism of rest position. In rest position the muscles are in tonus, but it is evident that the powerful elevators hold the lower jaw in place and prevent it from sinking farther down. Since a "forward slide" is in reality a slide forward and downward along the posterior slope of the articular eminence, this slide would occur against the elevating tendency of the most powerful mandibular muscles and, thus, could occur only under active contraction of the external pterygoid muscle. This movement, in turn, is in opposition to the state of rest or tonic relaxation of the muscles when the mandible moves from centric to rest position. It is, therefore, highly improbable that the movement of the mandible from centric to rest position is anything but a simple rotatory or hingewise dropping. Thus the same conclusion is reached as that mentioned previously; namely, that all the evidence militates against the assumption that the ideally balanced or centric position of the mandible is its most retruded position and for the theory that the condyle is slightly in front of this extreme or marginal position when there is total harmony of the masticatory structures, teeth, muscles and joints.

STUDY OF MANDIBULAR MOVEMENTS

The study of mandibular movements has received a strong stimulus from the application of electromyography to the examination of mandibular musculature. Much has been accomplished by this method, much more can and will be achieved. Unfortunately, however, it has happened again that a new method, or technic, is applied with more enthusiasm than critical judgment, and several inaccurate interpretations have already found their way into the literature.

In order to evaluate the results of

electromyography, these results must be combined with and checked against the knowledge of general and special muscle physiology. One point especially needs to be stressed. The electromyograph registers the action potential of a muscle; that is, it shows when and how strongly a muscle acts, but it does not and cannot show in which capacity the muscle activity occurs. Muscles can contract isotonically or isometrically. If they contract isotonically, they shorten and retain tension; if they contract isometrically, they tense but do not shorten and thus retain their length. By isotonic contraction muscles act as movers, by isometric contraction they act as holders, stabilizers, positioners. There is furthermore a contraction of a muscle in preparation for its relaxation in order to brake or balance the moving contraction of its antagonist. A simple example will make this clear. If a person lifts a load by bending the elbow, the biceps and triceps muscles—the flexor and the extensor—contract simultaneously. Then while the biceps continues into the isotonic contraction of a mover, the triceps gradually relaxes to balance and smooth the movement; but at the same time the muscles around the shoulder contract isotonically to position and stabilize and to hold the arm as an operational basis. All these muscles would show an electric action potential, but only through anatomic and physiologic analysis will their role in this complicated play be revealed.

For the movement of a freely movable joint, for instance, the ball and socket joint in the shoulder, all the muscles in all movements act in perfect and smooth interplay, some as moving, others as balancing forces. The freely movable temporomandibular joints, that can be classified as hinge joints with movable, sliding sockets, act in the same manner. The disks, of course, are the sockets for the condyles.

It is unfortunate that again and again the question is being asked: Which muscle is the opener of the jaws? Since it is obvious that the only protrusive muscle, namely, the external pterygoid muscle, acts during the normal opening movement, one or the other of the articular ligaments is thought to act as a "guy rope," fixing a certain point of the mandible while the external pterygoid muscle acts. Here again a basic principle is being overlooked. In a freely movable joint no ligament and no part of the capsule can be taut except as a check ligament in extreme positions. Any other arrangement would restrict free movement. Therefore, neither the temporomandibular ligament nor the fascial structures, wrongly called sphenomandibular and stylomandibular ligaments, can direct movements of the temporomandibular joint. If the picture of a guy rope is to be maintained, such a structure is present in the geniohyoid and digastric muscles; but these are living, muscular "ropes" that are capable of maintaining their tension while the mandible moves. While they pull the chin downward and, mainly, backward, the external pterygoid muscle pulls the condyle, and with it the disk, forward and downward. Thus, the peculiar combination of slide and rotation is achieved. It is, furthermore, obvious that at the same time the elevator muscles act as stabilizers by gradually relaxing after an initial and preparatory contraction.

How carefully electromyographic results must be interpreted can best be shown in the lateral movements of the mandible. If the chin is moved to the right side, activity of the left external pterygoid muscle and of the posterior bundles of the right temporal muscle can be ascertained. From these observations it has been concluded that the posterior bundles of the temporal muscle move the mandible to the ipsilateral side while apparently the external pterygoid moves the mandible to the contralateral side. This, however, is a misinterpretation of correct observations. During the shift of

the chin to the right the left external pterygoid muscle is the prime mover while the right temporal muscle contracts in order to hold the right condyle in place so that the mandible can rotate around it. Furthermore, the contraction of the retracting fibers of the right temporal muscle occurs after an initial swing of the entire mandible laterally and anteriorly to avoid strain in the capsule that would be caused by a rotation of the resting condyle *in situ*. This movement illustrates another principle in muscle action, namely, that of split-second timing. It is clear also that this time lag between contraction of the left external pterygoid muscle and the right temporal muscle is responsible for the Bennett movement.

The versatility of muscles and also the necessity for more intensive study in the analysis of their function are aptly illustrated in the following experiment. If a person thrusts the mandible forward by the activity of both external pterygoid muscles, he can still shift the chin to the right side. The main actors in this movement are the left external pterygoid muscle and the right posterior temporal muscle bundles; but now they have reversed their activity. Now the left external pterygoid muscle holds the left condyle in its forward position, while the right temporal muscle pulls the right condyle back. In the movement to the right from median occlusal or rest position, the left external pterygoid muscle contracts isotonically, the right temporal isometrically; but if the same end position is reached from an initial forward thrust, the right temporal muscle contracts isotonically and the left external pterygoid muscle isometrically. That in all these movements the other mandibular muscles also play their braking and stabilizing role is self-evident.

One more example of the importance of timing in the function of the neuromuscular apparatus should be mentioned because it provides an insight into the pathology of the temporomandibular joint. If the mouth is opened maximally, the condyles with the disks slide to the height, and in most individuals even slightly anteriorly to the height, of the articular eminence. This position might be termed a physiologic anterior dislocation. Then if the jaws are closed, it is of greatest importance that the external pterygoid muscles, which are maximally contracted at the end of the opening phase, relax a split second before the elevators and retractors go into action. Failure in this timing, for instance in a spasm of yawning, leads inevitably to a pathologic forward dislocation and to a locking of the mandible in its terminal opening position. For this reason the temporomandibular joint is the only articulation in our body that can be dislocated for the first time by its own musculature without the application of external force.

Prevention Versus Correction • To train enough professionals to keep all the people well by curing disease would involve an expenditure of so large a fraction of the income of any nation as to make the cure less attractive to the taxpayer than the disease. Indeed, if we tried to do the job today without our present knowledge of preventive medicine and public health, the situation would be hopeless. . . . ***James Bryant Conant.***

Concepts regarding function of the stomatognathic system

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The restorative dentist and the orthodontist are concerned primarily with treating esthetic and functional aberrations of the stomatognathic or masticatory system. Comprised of the teeth and their supporting tissues, the mandible and maxilla, the two temporomandibular joints and the muscular, nerve and vascular systems, the stomatognathic organ functions continuously in mastication, deglutition, speech and respiration and in maintenance of the posture of the head, mandible, tongue and hyoid bone. In order to evaluate properly abnormal form and abnormal function it is necessary to understand the anatomy, growth, and physiology of this system or organ. Mechanical therapy and restorations used in treatment must conform to the fundamental physiology of all of the parts as they function collectively and interdependently as a biological unit. If the technical procedures violate any of the anatomical and physiological principles concerned, they will fail to attain the objective of restoring normal function and may even further enhance the abnormal function.

The temporomandibular joints and the musculature are the least changeable and the least adaptable of all the parts. The form of the joints is established early, and with the exception of normal growth in the child, the only changes are slight wear induced by use over the years and degenerative alterations in form caused by disease or prolonged abnormal function.

All skeletal muscles including those that attach to the mandible have a given physiological resting length. They lengthen and shorten in function, but they always return to their given physiological tonic or resting length. The head resting on the spinal column is designed to be moved by the neuromuscular system through various functional positions, but it cannot be held for long in a tilted or rotated position without the musculature that creates the movement becoming strained and fatigued. There is a natural, unstrained, comfortable, upright position for the head in which all of the muscles are at their physiological resting length. Likewise there is a position for the mandible in which it can be held in a relatively stable position through all of the muscles assuming their physiological resting lengths. Although the mandible is moved by the musculature in function, it cannot be maintained in an open mouth position, or with teeth in occlusion, or in a lateral or protrusive relation as a static position without the musculature soon becoming fatigued.

Presented in the postgraduate course, "Analysis and Treatment of the Stomatognathic System," Chicago, Northwestern University Dental School, April 1, 2 and 3, 1953.

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BASIC POSITIONS OF THE MANDIBLE

There are three basic positions of the mandible. They are the rest position, the occlusal position and the centric position. The rest position of the mandible is dependent entirely on neuromuscular physiology. All functional movements of the mandible begin from and end in the rest position (Gillis[1]) because only at that position is the mandibular musculature in tonic equilibrium.

When the mandible is in the rest position, an interocclusal clearance (freeway space) of two, three or more millimeters, with individual variations, exists between the maxillary and mandibular teeth. It must be thought to exist not only in the vertical but in all planes of space; namely, anteroposterior, lateral and oblique. The size of the space when expressed as 2 or 3 mm. represents the difference between the rest vertical and occlusal vertical dimensions of the face (nasion to gnathion). The space or clearance has a normal pattern that is roughly wedge-shaped, being larger in the incisor than in the molar area. The lower surface is an irregular plane with elevations and depressions that correspond to elevations and depressions in the upper irregular plane. Tooth cusps may be intruded into the functional space not only by elongation of a tooth but also by mesial, distal, buccal or lingual movement so that elevations contact opposing elevations rather than depressions (Freeman[2]).

The rest position, or rest relation, is established before the teeth have erupted. It is not altered in proportion to the total face by the eruption of the teeth and growth of the face, and the rest position has a high degree of stability even after the teeth are lost. It cannot be altered permanently by any restorative or orthodontic procedure. Furthermore, the presence or absence of the teeth does not influence the resting length of the mandibular musculature (Brodie and Thompson[3,4]). The musculature, then, is an important part of the masticating organ for the positioning of the mandible as well as for the motivating of its functional movements.

VARIABLES IN THE REST POSITION

There are variables in the rest position, the existence of which must be recognized, and since a broader concept of mandibular positioning has been established with the concept of a stable rest position, these variations can be recognized and understood more easily. They are related to variations in the tonicity of the musculature such as (1) hypotonicity, as seen in fatigue, disease, and conditions of generally diminished muscular tone, and (2) hypertonicity, which in the extreme is muscle trismus. The hypertonicity may completely alter or eliminate the normal rest position. In such instances the case history of subjective symptoms and the recognition of objective symptoms (clicking or crepitus in the temporomandibular joints, limitation in opening, and so on) aid in the analysis and in the determination of the correct mandibular position. Another variant often exists when the maxillary incisors are inclined to the lingual. Such inclination restrains the mandible from assuming its resting position. Once the incisor inclination is corrected and the musculature can assume its normal postural function, rest position can be observed.

Muscle tone diminishes with fatigue, hence under conditions of fatigue gravity would be resisted less by the musculature and it could be assumed that this would

1. Gillis, Robert. Establishing vertical dimension in full denture construction. J.A.D.A. 28:430 March 1941.

2. Freeman, A. G. The intermaxillary space, normal and abnormal. Thesis, Northwestern University Dental School, 1948.

3. Thompson, J. R., and Brodie, A. G. Factors in the position of the mandible. J.A.D.A. 29:925 June 1942.

4. Thompson, J. R. Rest position of the mandible and its significance to dental science. J.A.D.A. 33:151 Feb. 1946.

modify the relation of the mandible to the maxilla. The change in maxillomandibular relation may not be as marked as at first it might be assumed to be since the posture of the entire body is similarly modified. The changes that could be introduced over the years with the changing posture that results from the aging of the bodily tissues has never been measured. Granted that such a change is probable, it is so gradual that it is of no practical importance. Changes introduced by certain debilitating diseases such as poliomyelitis are profound, but these constitute a deformity rather than a variation.

OCCLUSAL AND CENTRIC POSITIONS

When the mandibular teeth are moved into occlusion with the maxillary teeth, the occlusal position (often referred to as "centric position") is established. This is a functioning position through which the mandibular teeth move in contact with the maxillary teeth in mastication, and it can be maintained as a static position only with increased muscular effort. Since this position is dependent entirely on the dentition, it is changed as the dentition is mutilated, and it is lost when the teeth are extracted.

It was stated that when the teeth are occluded, they determine the occlusal mandibular position, and that position should be identical with the centric position of the mandible. Centric position (often referred to as "centric relation") not only is that maxillomandibular relation where the teeth should occlude in the normal or good functional situation, but also where each condyle of the mandible is in a balanced position in its mandibular fossa. This balanced position exists when the condyles are in their unstrained positions in contact with the fibrous tissues that form the posterior walls of the articular fossae and when the anterosuperior surfaces of the condyles are in close approximation to the posteroinferior surfaces of the articular eminences that form the anterior walls of the articular fossae with the thin central portion of the articular disk interposed. From this balanced position in the articular fossa a condyle can be protruded considerably and retruded slightly with muscular activity. Furthermore, in respect to movement it can be said that if the path of closure from rest position to occlusion is an approximate hinge movement with the mandibular teeth moving through an acceptable interocclusal clearance, the occlusal position and centric position will be identical. It has been shown, however, that in many individuals the path of closure is not normal. The mandible is shifted bodily on an upward, upward and backward, downward and forward, or lateral path, whatever the case may be, in order to occlude the teeth. In these instances the occlusal position and centric position are different, and an abnormal functional situation exists. These are conditions of mandibular displacement.[5-8]

On closure from an open mouth position or during mastication, the mandible closes directly into the position of displacement without being directed by the dental interference. This is accomplished by a neuromuscular adaptation, initiated by the nerve endings in the periodontal membrane spaces of the interfering teeth, that serves as a mechanism of protection to the supporting tissues of the teeth. On closure from rest position, however, the mandible is seen to close, make the initial contact and then continue to close but now on an abnormal path into the ab-

5. Thompson, J. R. Temporomandibular disorders, diagnosis and dental treatment. In The temporomandibular joint, Sarnat, B. G., editor. Springfield, Ill., Charles C Thomas, 1951, ch. 7.

6. Thompson, J. R. Rest position of the mandible and its application to analysis and correction of malocclusion. Angle Orthodont. 19:162 July 1949.

7. Thompson, J. R. Oral and environmental factors as etiological factors in malocclusion of the teeth. Am. J. Orthodont. 35:33 Jan. 1949.

8. Thompson, J. R., and Craddock, F. W. Functional analysis of occlusion. J.A.D.A. 39:404 Oct. 1949.

normal occlusal position. Although reference is made to neuromuscular adaptability, it must be remembered that muscles cannot adapt themselves to permanent lengthening.

VARIATIONS IN CLOSING MOVEMENTS OF THE MANDIBLE

Anatomical knowledge of joint function and roentgenographic studies on the closing movement of the mandible from rest position to occlusion of the teeth made on young adults with excellent occlusions indicate that the lower portion of the joints functions primarily in this movement (Boman,[9] Schwartz,[10] King[11]). The normal movement of the mandible from rest to occlusal position is almost that of a hinge with the common axis located in the vicinity of the condyles or lower portions of the joints. The mandibular incisors and the chin point swing upward and forward. The molars move on a similar but smaller arc since they are nearer to the axis. It is important to note that there may be slight bodily movement of the condyles, but slight movement of the condyles should still be considered to be within the normal range. The apparent bodily movement indicated on some roentgenograms of the joint actually may still be a hinge movement if the axis is below the center of the condyles. Physiologically there may not be a true axis as it is interpreted in a mechanical sense.

In roentgenographic studies on the closing movement from rest position to occlusion in children with excellent mixed dentitions, more variation from the hinge type of movement is observed (Donovan[12]). This is apparently the normal or usual situation for this age range. As the individual approaches maturity, the pattern of closure described for the young adults becomes the rule in the normally functioning masticating organ.

On opening the mouth from occlusion, the hinge movement functions until rest position is exceeded, then the condyles move downward and forward. The joint is now functioning as a hinge, the socket of which is moving (Sicher). The movement of the socket or bodily movement of the condyles occurs in the upper portion of the joint between the articular disk and articular eminence. The condyle and disk are gliding on the condylar path which is determined by the form of the articular eminence, and this does not change over the years once growth is completed.

In performing the functions of speech, the mandible moves through the various positions combined with oblique, lateral, protrusive and retrusive movements without tooth contact. These require coordinated action of the upper and lower sections of the right and left joints. In mastication the mandible should move through the occlusal positions with tooth contact but without occlusal interference, in harmony with the paths created by the articular eminences within the individual's functional range. This is balanced articulation of the teeth and it will be referred to in more detail in discussing abnormal function.

MANDIBULAR DISPLACEMENT

It was stated that mandibular displacement may occur in any direction; namely, anterior, lateral, or posterior in the horizontal and oblique planes, and inferior (excessive occlusal vertical dimension) or superior (deficient occlusal vertical dimension) in the vertical plane. Some dis-

9. Boman, V. R. Roentgenographic study of the movement of the mandible from physiological rest position to occlusion of teeth. Thesis, Northwestern University Dental School; 1948.

10. Schwartz, Edward. Radiographic and clinical study of temporomandibular joint in young adults with excellent occlusion of the teeth. Thesis, Northwestern University Dental School, 1952.

11. King, W. A. Radiographic analysis of a clinical determination of the transverse axes of the movement of the mandible. Thesis, Northwestern University Dental School, 1951.

12. Donovan, R. W. Roentgenographic study of various mandibular positions of children possessing excellent dental occlusions. Thesis, Northwestern University Dental School, 1950.

tinction must be made between mandibular overclosure and the combination of mandibular overclosure and mandibular displacement. Displacement of the condyle into an abnormal position in the articular fossa occurs only when there is tooth interference causing horizontal or oblique mandibular displacement as the neuromuscular system moves the mandible directly into the abnormal occlusal position. An experiment performed on a group of edentulous individuals where maximum overclosure was possible showed that little bodily movement or displacement of the condyle took place in the movement from rest position to the position of maximum overclosure. Many abnormal functional conditions of the joints are corrected when the individual becomes edentulous.

VERTICAL DIMENSION

Reference is often made to the vertical dimension of the face, but actually there are two vertical dimensions to be considered—one when the teeth are in occlusion, the occlusal vertical dimension, and the other when the teeth are separated and the mandible is at physiological rest position, the rest vertical dimension. This concept is not new (Gillis,[1] Niswonger,[13,14] Tench,[15] Pleasure,[16] Boos,[17] Schlosser,[18] Holic,[19] and others) but it most certainly has not been fully appreciated.

The first, occlusal vertical dimension, exists only during function when the teeth are in occlusion and it is amenable to changes with alterations in the occlusion. This dimension will decrease when the teeth are worn more rapidly than compensating eruption can occur, and it is lost when the teeth are extracted. The second, the rest vertical dimension, established by the mandible in its rest position, is greater than the occlusal vertical dimension, and it is constant in most instances regardless of the status of the dentition. The difference in the two face heights should be approximately 2, 3, or 4 mm., and this is the average allowance for the freeway space or interocclusal clearance that exists between the maxillary and mandibular teeth when the mandible is at rest position.

STABILITY OF REST POSITION

If the concept that the rest position of the mandible is dependent on the balance of its musculature is true, then abuse of this principle in any of the phases of dentistry should have undesirable results. Several years ago this problem was investigated by tracing the changes that occurred after the placement of prosthetic restorations. The evidence, reported in earlier publications, strongly supports the contention that the physiologic rest position of the mandible is stable and cannot be altered permanently by prosthetic dentistry. If the mandible is carried by artificial restorations to a position beyond that of physiologic rest, it will return to this position at the expense of unnecessary resorption of the supporting bone. It is essential, when determining the occlusal vertical dimension in restorative procedures, that the concept of a stable rest position be present in the mind of the operator and that it be applied in a practical manner. The most important step in any such technic is to understand the physiologic basis of rest position and to know that it is present.

13. Niswonger, M. E. Rest position of the mandible and centric relation. J.A.D.A. 21:1572 Sept. 1934.

14. Niswonger, M. E. Obtaining vertical relation in edentulous cases that existed prior to extraction. J.A.D.A. 25:1842 Nov. 1938.

15. Tench, R. W. Practical application of the physiological rest position. In Current advances in dentistry, Schour, I., and Levy, Saul, editors. Champaign, University of Illinois Press, 1949, p. 70.

16. Pleasure, M. A. Correct vertical dimension and freeway space. J.A.D.A. 43:160 Aug. 1951.

17. Boos, R. H. Occlusion from rest position. J. Pros. Den. 2:575 Sept. 1952.

18. Schlosser, R. O., and Gehl, D. H. Complete denture prosthesis, ed. 3. Philadelphia, W. B. Saunders Co., 1953, p. 189.

19. Holic, Richard. Centric registration in full denture construction. J.A.D.A. 36:296 March 1948.

Rest position has been used for years by many operators even without their realizing it as they question the patient, "Do the teeth hit too soon?" or as they use their "clinical sense" in evaluating the occlusal vertical dimension.

A frequent error has been to disregard the unalterability of the rest vertical dimension and unknowingly establish an excessive occlusal vertical dimension in the desire to enhance esthetics. It has been assumed that the vertical dimension is diminished when the teeth are worn or are lost by extraction and that the "sunken-in" appearance of the lips in the edentulous is the result of this decrease. Such incorrect interpretations as "the chin approaches the nose" when the teeth are extracted has led to this error. The facial changes associated with becoming edentulous are the result of the lips moving lingually as their lingual support, the teeth and alveolar processes, are removed rather than by a decrease of the rest vertical dimension.

It is accepted generally that most disturbances of the temporomandibular joints, other than direct infectious or traumatic injury to the condyles, are caused by abnormal occlusion or articulation of the teeth, but in order to diagnose the disorders the malocclusion must be analyzed by a functional method. Observing the occlusion with the teeth in static relation and then moving the mandible into various eccentric positions is not sufficient. A dynamic concept is necessary in order to evaluate the condition so as to produce an occlusion that is in functional harmony with the musculature and the temporomandibular joints.

In these days of technological advance it must not be forgotten that the most important research instrument is still the human mind, and that the most important diagnostic record to be studied is still the patient. It must also be remembered that only the patient is living, and that the evaluation of function can be accomplished only on the patient. All other records such as models, photographs, cephalometric, dental and joint roentgenograms offer clues and suggestions for the operator to interpret on the patient. The interpretation will more likely be correct if one has a broad knowledge of anatomy and physiology of the stomatognathic system as a basis from which to reason.

FUNCTIONAL ANALYSIS

Functional analysis includes the evaluation of the path of closure of the mandible from rest position to occlusal position, the amount of closure or size of the interocclusal clearance, and the pattern of the interocclusal clearance. The path of closure can be determined either clinically or on cephalometric and temporomandibular joint roentgenograms, but it is important first to observe and record the rest position. To do this the patient must be sitting or standing in an upright comfortable position. He is then engaged in natural conversation that will distract his thoughts from himself. After speaking, the individual usually swallows and the mandible settles toward rest position. The patient is then asked not to move the tongue, lips or teeth. The lips may or may not be separated and the operator may at first encounter some difficulty if he is required to part the lips in order to observe the teeth. Should movement be detected the process is repeated. Eventually an identical incisor relation will be noted and this should be recorded mentally. The tongue will be seen to be "creeping" into the interocclusal clearance, and if the space is large it will be filled completely by the tongue and buccal tissues. The patient is then requested to close slowly. In the ideal all of the teeth will occlude at the same time. Although these positions and path of closure are observable in the mouth, valuable information and a permanent record of the terminal positions can be gained through cephalometric roentgenography.

PREMATURE AND INITIAL CONTACTS

The pattern of attrition should be studied carefully on the models and in the patient. The normal pattern develops slowly and evenly over the occlusal, incisal and proximal surfaces of all the teeth. When some malocclusions are present, a few teeth may exhibit areas of attrition that are excessive when the age of the patient is considered. This fact may be a clue to abnormal function, and the areas of wear may be areas of premature or initial contact or areas of functional interference.

When the pattern is abnormal, two conditions must be recognized, (1) premature contact and (2) initial contact. Premature contact is contact of certain teeth within the interocclusal clearance. Since contact occurs before the mandibular teeth have passed through an adequate interocclusal clearance, the teeth in premature contact occlude with more than the normal force. These teeth have an abnormal amount of mobility, and they frequently become as sore as though periodontitis or pulpitis were present. It is particularly damaging if the neuromuscular adaptation cannot manipulate the mandible so as to avoid the premature contact.

If, on the other hand, the mandible closes through a reasonable interocclusal clearance on a normal path and then certain teeth occlude before the others, a condition of initial contact exists. After the initial contact, the mandible is directed onto an abnormal path of closure until the remaining teeth occlude in a position of mandibular displacement and, in some instances, mandibular overclosure. Teeth in initial contact usually are not loose or sore as they are not being occluded with an excessive amount of pressure because of the neuromuscular adaptability to the abnormal path of functional closure. Electromyographical studies now under way in a number of the universities are revealing additional valuable information regarding this problem.

Although the distinction between premature contact and initial contact is largely a matter of judgment rather than actual measurement, it is important to differentiate between them as accurately as possible in order to insure correct treatment. In the former, the area of premature contact must be removed by moving the tooth or teeth orthodontically in the horizontal plane or by occlusal grinding. In the latter, since the mandible has passed through an acceptable interocclusal clearance, the other teeth must be permitted to erupt or must be restored to the vertical level of the initial contact. It must be understood that some cases require a combination of these treatments.

To determine whether a premature contact exists, the patient, sitting upright, is requested to tap the teeth together while the operator listens with his ear close to the patient's mouth. Normally a single sharp tap should occur as the teeth occlude evenly, but if premature contact exists a double tap is emitted by the uneven occlusal contact. If the premature contact is present, the next step is to locate the tooth or teeth at fault. To do this the finger is moved slowly without pressure over the gingival tissues of the upper teeth as the teeth are tapped together. The teeth in premature contact will be felt to move against the finger. Mesial or distal displacement of the teeth is more difficult to detect by the tactile sense of the operator, but slight deviation of the mandible (forward, backward, or lateral) and teeth (vertical or buccal) as the teeth are occluded can be detected visually by close observation. The tactile sense of the patient's periodontal membrane will by this time enable the patient to point to the offending teeth.

All teeth in premature contact have excessive mobility, and the excessive

movement is in the direction of the tooth displacement. When the jaws are separated the teeth move to a central or balanced position in their alveoli, but when they are closed in occlusal contact the teeth in premature contact are thrust into positions of tooth displacement. For this reason it must be realized that occlusal relations in an accurate set of casts may seem to differ from the occlusal relations observed in the mouth. When the impressions are taken the teeth are out of occlusion, and the teeth are in their central positions in the alveoli. When the models are occluded, the areas of premature contact will occlude with heavier contact. These areas may chip or break since the plaster teeth cannot be displaced as happens to the teeth. This occurs usually when the models are being trimmed.

In evaluating mandibular position in locating areas of premature contact, Williams[20] makes the following significant statement:

> There are a number of methods of inducing a patient to close his jaws in true centric occlusion. If the patient will swallow and allow the teeth to close until the first point of occlusal contact is established the teeth usually will be extremely close to their true centric occlusion.

TOOTH RELATIONS

The next phase of functional analysis is to analyze critically the tooth relations in lateral and protrusive movements of the mandible. It is essential that functional harmony be achieved through the elimination of points of interference that may be seen to exist within the individual's functional range of movement. The functional interference is located by resting the finger lightly in the gingival portion of the maxillary teeth as the mandible is jiggled laterally with the teeth rather firmly occluded. The teeth in interference will be felt to move against the finger. The fingers may also be rested on the mandible, and as it is moved with the teeth occluded a "bumping or jumping" sensation may be felt.

As the mandible is moved into protrusion the fingers should rest on the gingival portions of the maxillary teeth. If the incisal guidance is too steep, the incisors will be felt to have more movement than is judged to be normal. The patient again may assist in locating the areas at fault in the various functional movements.

The functional range should be observed carefully because interferences that are observed when the individual moves the mandible from the occlusal position into lateral position may be outside the functional range. The functional range is best determined by having the patient masticate wax that maintains its consistency ("chew-in-wax"), as the lips are held slightly parted by the operator. In most instances the stroke is predominantly vertical with only slight oblique or gliding movement. As the consistency and resistance of the bolus are increased, more lateral gliding is introduced. Therefore the functional path exhibited on the test wax may not include the entire functional range utilized in masticating meat or fibrous foods. As the patient is masticating the test wax he is requested to stop just as the teeth are separated to start another stroke before the tongue can manipulate the wax bolus. When it is removed certain areas may be seen to be torn or penetrated. These usually are areas of excessive functional contact.

This is now followed by a more exacting procedure. A section of the wax is placed over the upper teeth on one side and is held there by the operator by the portion of the wax which extends out of the mouth. The patient is again asked to masticate, and after two or three strokes the wax is removed. The areas in excessive functional contact will tear or perforate the wax. As these are relieved the subsequent wax records will show a more

20. Williams, C. H. M. Correction of abnormalities of occlusion. J.A.D.A. 44:748 June 1952.

even pattern formation without perforations.

Another method of applying the wax is to soften a piece of baseplate wax in warm water and then fold it on itself to form a double thickness. It is trimmed to extend a little beyond the buccal and incisal portions of the teeth. The slightly softened wax is placed on the upper teeth, and after first closing into the occlusal position to seat the wax on the upper teeth, the patient is instructed to chew on one side and then on the other for a few strokes. If difficulty is encountered by the patient in attempting to chew normally on the wax, the procedure can be modified. After the teeth are closed into occlusion the patient is instructed to move the mandible slightly into right and left lateral positions. This may not exactly duplicate the masticating stroke as it is proceeding in the opposite direction, but in most instances it is sufficient. Areas of premature contact will perforate the wax, and the areas of perforation on the balancing or nonfunctioning side can be differentiated easily from like areas on the working or functioning side. Again, as the areas are relieved a uniform pattern without perforations is obtained.

It should be noted that in these methods of using the wax, the effort is made to record the premature contact areas within the functioning range of the individual. This, of course, will be modified by neuromuscular adaptability as the occlusion is improved. The functional testing methods are not meant to replace any method of testing for premature contact of teeth now in use, but rather to supplement them in a functional manner.

Finally the articulating paper is used, but it must be applied in a specific manner. The section of paper is held in a pair of pliers so that the beaks of the pliers are at the mesiobuccal cusp of the upper first molar. This is done so that when the paper is removed it can be observed for perforations. The operator is able to orient the perforations from the position of the pliers with relation to the first molars. The corresponding areas of perforation are examined in the mouth, and they will be observed to be a circle rather than a solid mark. The reason for this is that as the paper is perforated the contacting tooth surfaces erase that part of the carbon mark. These are the areas to remove by occlusal adjustment. The adjustment is made first in centric and occlusal positions which usually are identical or nearly so in conditions of premature contact with certain of the teeth being thrust or "jiggled" into abnormal positions. The adjustment is then made to remove the functional interferences within the functional range by occlusal grinding, carefully observing the principles of occlusal equilibration formulated by Schuyler.[21] This is done until the mandibular movements are free, and easy to perform, and the teeth are felt not to have excessive movement.

EVALUATION OF TEMPOROMANDIBULAR JOINTS

The last phase of functional analysis, probably the most neglected one but one that is exceedingly important to the functioning and well-being of the stomatognathic system, is the evaluation of the temporomandibular joints. The usual roentgenograms of the joint made with the teeth occluded and the mouth open are of little value in most cases. The comparison of the mandibular rest and occlusal position in roentgenograms of the joint may suggest displacement of the condyle[22, 5] but the best evaluation can be made directly on the patient.

The fingers are placed lightly over the joints in order to distinguish crepitus as the mandible is moved. The patient

21. Schuyler, Clyde H. Fundamental principles in the correction of occlusal disharmony, natural and artificial. J.A.D.A. 22:1193 July 1935.

22. Lindblom, Gosta. Technique for roentgen-photographic registration of different condyle positions in the temporomandibular joint. D. Cosmos 78:1227 Dec. 1936.

may complain of "clicking" that is audible during mastication, or the crepitus may be so slight that it can hardly be detected. The "clicking" or crepitus represents abnormal joint function caused usually by malocclusion of the teeth. Irregular movement may be observed as the mouth is opened as there may be a limitation of mandibular movement. The patients may complain of localized or referred pain. Very often they state that at one time one or both of the joints "clicked" during mastication, but that this stopped when the joints became painful. A painful joint is limited in movement, and the midline will deviate toward the side of pain. This is because the painful joint is moving as a hinge but very often with the condyle restrained in a position of displacement.

The superior head of the external pterygoid muscle is attached to the anterior margin of the articular disk, and the lower portion is attached to the neck of the condylar process of the mandible. Sicher[23] has pointed out that an important function of the superior head of the external pterygoid muscle is to prevent posterior movement of the disk. If posterior displacement is present the mandible must be moved on an upward and backward path in order to oclude the posterior teeth. A click occurs as the condyle moves posteriorly over the posterior margin of the disk. The click indicates a dislocation in the lower portion of the joint (normally hinge action only takes place in the lower portion), the disk being restrained from going posteriorly with the condyle by the superior head of the external pterygoid muscle.[23] The lower portion of the external pterygoid muscle is overextended when the teeth are occluded and it may cause muscle pain, trismus or irregular function.

It was stated that a click occurs as the condyle moves posteriorly. Another click takes place as the mouth is opened. If the teeth are not occluded, the clicking will not occur as the mandible moves in the function of speech except in extreme cases of abnormal functioning. Once again, when the teeth are occluded, the click occurs. The click represents impingement of the posterior margin of the articular disk in the pressure area between the anterosuperior surface of the condyle and superior portion of the posteroinferior surface of the articular eminence. This is followed by "snapping" into or out of position as the condyle and disk are moved discordantly. If the dislocation is prevented by the placement of thin occlusal splints that modify the distorted pattern of the interocclusal clearance, the clicking stops at once.

It is important to realize that in the elimination of posterior displacement the condyle is moved to its normal position in the articular fossa and not into a position of protrusion on the articular eminence. The distance of repositioning is usually less than 1 mm. Any attempt to move the condyle into a static position of protrusion from its normal balanced position will result in failure.

Clicking at partial opening occurs when the condyle begins to move forward from its position of displacement. Until this occurs the opening is a hinge movement with the condyle remaining in the position of displacement. Normally the condyle should move downward and forward as rest position is exceeded.

Another important cause of abnormal function of the joints is tooth interference during function (Schuyler[24]). Tooth interference on the functioning side in the posterior teeth may cause the condyle on that side to be forced away from its normal path of gliding on the articular eminence. The movement will be difficult to perform. The articular disk is still maintained in close contact with the articular eminence by the superior head of the external pterygoid muscle so the "break-

23. Sicher, Harry. Oral anatomy. St. Louis, C. V. Mosby Co., 1949.

24. Schuyler, Clyde H. The effect of abnormalities of occlusion upon the temporomandibular joint and associated structures. Proc. D. Centenary, p. 303, 1940.

down" again occurs between the disk and the condyle. The disk and the condyle then do not move in unison during function. Schuyler,[21] Beyron[25] and others have emphasized the importance of recognizing and relieving interference on the balancing or nonfunctional side in articulation. Severe interference on the functioning side may likewise cause abnormal function of one or both joints. Again certain movements will be difficult to perform because the abnormal tooth guidance is forcing the condyle away from its normal path of guidance on the articular eminence. Relief of the interference stops the abnormal function immediately, and the mandibular movements that were limited are carried out with ease.

One of the most common situations in which tooth interference occurs is the overeruption of mandibular third molars. At first, there will be a condition of premature contact when the teeth are displaced, but as the overeruption continues the interference becomes more severe, with the mesioocclusal surface of the lower third molar articulating with the distoocclusal area of the upper second molar. Polished areas of attrition become apparent on these surfaces. Then the tooth guidance dominates the normal guidance of the articular eminence, and the condyle is forced away from the articular eminence in function. Eventually, as the overeruption continues, a condition of posterosuperior mandibular displacement develops. The affected joint will click during movement and it may become painful. When pain is introduced there is also limitation of movement and the clicking stops.

CLASSIFICATION OF ABNORMAL FUNCTION

The abnormal functional conditions may be classified generally into three groups. There is, of course, some overlapping of the groups.

I. Premature contact at centric position (occlusal position is identical with centric position), manifesting the following characteristics on examination:
   a. Double tap
   b. Certain teeth jiggle
   c. Teeth thrust away from central position in alveoli
   d. Supporting tissue and pulp tissue possibly inflamed and painful
   e. Normal path of closure.

II. Interference in function.
   1. Displacement of teeth without displacement of mandible, manifesting the following characteristics:
      a. All or some of the characteristics of premature contact
      b. Normal path of closure
   2. Altered functional movement of the mandible with the condyle being forced away from its normal path on articular eminence, manifesting:
      a. Abnormal function of temporomandibular joints
      b. Normal path of closure

III. Mandibular displacement (in any direction), manifesting the following characteristics:
   1. Abnormal path of closure
   2. Abnormal function of temporomandibular joints
      a. Unilateral
      b. Bilateral

TECHNIC FOR CONSTRUCTING TREATMENT SPLINTS

After experimenting with numerous methods of constructing occlusal splints for the elimination of mandibular displacement, a semidirect technic was developed. It is exceedingly accurate since dimensional changes of various materials are eliminated.

1. An impression is taken of the dental arch on which the splints are to be placed.
2. A stone model is poured.

25. Beyron, Henry. Occlusal relationship. Internat. D. J. 2:467 June 1952.

3. A base splint is waxed with one thickness of baseplate wax, and this is processed in acrylic resin. No attention is paid to occlusion at this time.

4. The base splint is tested in the mouth for accuracy of fit and ease of removal.

5. A roll of rapid setting endothermic acrylic resin is attached to each side of the base splint.

6. The splint is placed in the mouth, and the endothermic acrylic resin is rolled or pressed over the posterior teeth.

7. The patient is directed to move his mandible into the predetermined occlusal position and is instructed to hold it in this position. This position is usually at the level of the initial incisor contact.

8. The splint is smoothed and polished so that the ridges are not pronounced. It is not necessary to "lock" the occlusion.

9. The splint is checked and adjusted carefully in the mouth to eliminate as much functional interference as possible and it must be comfortable to the patient or else it is incorrect and it must then be reconstructed. The interference on the arc of the closing movement (posterior margins of the depressions) and the interference on the working and balancing sides must be relieved so that the functional movements are as free as possible.

10. The dentist can proceed with the permanent restorations as soon as the subjective and objective symptoms have subsided and the patient decides that the established occlusal position is correct. The objective symptoms should be relieved immediately.

COMMENT

Abnormal function of the temporomandibular joint occurs frequently during orthodontic treatment. It is imperative that the joints be examined as regularly by the orthodontist as he examines the occlusion, as the two cannot be separated. Additional tooth movement should be planned to correct any abnormal function, whether it be present before or develop during treatment. It may also develop during retention as the individual grows and disharmony develops between the existing occlusion and position of the condyle in the fossa with the teeth in occlusion. For this reason each patient receiving orthodontic treatment must be observed during entire growth period.

SUMMARY

Harmonious relations at rest and in function of all the parts of the stomatognathic system should be the primary objective in the practice of general dentistry and orthodontics. This requires skillful technical procedures that conform with the biology of the living mechanism. As this concept is accepted, the practice of dentistry becomes more complex, but also it is realized that so much more can be accomplished for the patient. Its scope is expressed by McCullom[26] in saying:

Oral diagnosis and the knowledge underlying it are not for any particular specialty of dentistry. The procedures parallel and are in principle applicable to all branches of the healing art, because these principles are born of physiologic and anatomic knowledge.

He concludes his paper describing the anatomy and physiology of the oral organ by saying:

This discussion is not presented with any undue desire to impress the reader with one's profound knowledge of the inexhaustible problems of oral anatomy and physiology, but in the hope that it may awaken a keen appreciation of the need for a basic understanding of the function of the organ that dentistry has obligated itself to treat.

Black aptly stated the obligation of the dentist to his patient by saying, "The professional man has no right to be other than a continuous student."

26. McCollum, B. B. Oral diagnosis. J.A.D.A. 30:1218 Aug. 1943.

Functional relations of the stomatognathic system

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Man is an omnivorous animal. With his temporomandibular joints and teeth he can perform the hinge action, the tearing and shearing of the carnivora, and the gliding and milling of the herbivora. Furthermore, he must be able to execute these actions singly or simultaneously without injury to any part of the chewing mechanism. The irregularities of occlusal form which are designated as cusps, sulci and marginal ridges exist so that man can perform these varied functions, as a physiologic necessity in order to maintain functional equilibrium throughout the entire oral organ—teeth, bones, joints and muscles.

The movements of the mandible and of the muscles of mastication are all designed to chew with cusps. The architecture of the bone in which the teeth are embedded is there for the purpose of receiving the forces from the cusps; these forces may be physiological or pathological. Lack of adequate knowledge and failure to recognize this fact have resulted in acute failures, and in desperation many have turned to the equally pathological flat teeth with little or no cusps at all. A differentiation is not being made between mere balance of teeth themselves and proper articulation as a requisite to functional equilibrium.

METABOLIC FACTORS

Fundamentally, the problem of maintenance of tissues of the mouth is the same as it is for maintenance of any tissue of the body. Man is a coordinated whole with all of his parts interdependent on each other. The mouth and its tissues are subject to all the factors—biomechanical, neuromuscular—and those factors which, taken together, comprise the metabolism of the individual. The mouth, likewise, is a complete integrated organ, and the modern dentist realizes that he must treat the entire mouth, not merely its individual parts. In the final analysis dentists are dependent on nature's metabolic processes to maintain the mouth. There is a direct, definite relationship between the mechanical procedures of dentistry and the metabolic activity of the structures adjacent to the teeth.

The metabolic requirements of tissue depend on its functional demands. It is difficult to draw a sharp dividing line between function and stress. If a man falls down a long flight of stairs, that is stress in the traumatic sense. On the other hand, if a man climbs a long flight of stairs to the point of exhaustion, that is function carried to the point of excessive functional demands. That likewise is stress, but it is not trauma.

Function, likewise, can be a destructive force; it is catabolic and in a certain sense consumes tissues. Anabolism attempts to rebuild and maintain the tissues against the ravages of function. The more tissue is required to function, the greater effort nature must make to repair the

Presented in the postgraduate course, "Analysis and Treatment of the Stomatognathic System," Chicago, Northwestern University Dental School, April 1-3, 1953.

damage, or to put it another way, the less is the body able to maintain it. In healthy functioning tissue there is a constant process of breakdown and repair, and in general, tissue is completely replaced every six months. After the period of growth, metabolism gradually decreases with the passing years, as a result of endocrine factors.

It follows then, that if the functional demands on tissue can be reduced, the metabolic requirements are also reduced, and nature is better able to maintain that tissue at any metabolic level. There would seem to be little point in preserving teeth from carious loss, only to have them present a much more potent health menace. The treatment of caries and advanced periodontal disease is not enough. The destructive process which precedes the infection must be stopped by reducing the metabolic requirements resulting from excessive functional demands, so that nature can maintain the supporting structures in a state of health.[1]

Two practical courses are open to the dentist. First, the metabolism can be built up within the limits of present knowledge; however, treatment by increasing metabolic factors alone frequently is not adequate. It will be limited by the amount that metabolic activity falls below functional demands. In the mouth the functional demands on the supporting structures can be reduced by distributing the function over more tissue. Therefore the basic object of any restorative procedure is to create cusps which will maintain contact between all the teeth and distribute the force equally throughout the oral structures, in all the functioning ranges of tooth contact, as a means of maintaining metabolic equilibrium in the mouth. The more cells that can be used to perform a given function, the less metabolic demand per cell, or the more the anabolic build-up equals the catabolic breakdown to maintain the tissue against function. A true "balanced occlusion" is that cusp relation which maintains a state of functional equilibrium throughout the entire mouth.

MANDIBULAR RELATIONSHIPS

The movements of the mandible and the articulation of the teeth are activated by the muscles of mastication, but they are controlled by the temporomandibular joint. The functional relations of the teeth to each other must be determined by their relation to the temporomandibular joints. The functional demands on the bone and soft tissues supporting the teeth are directly related to how well the articulation of the teeth corresponds to the movements of the mandible as determined by the temporomandibular joint. In a healthy arrangement of teeth the cusps do not dictate the movements of the mandible; they maintain continuous contact by following mandibular movements as dictated by the temporomandibular joint.

The paths of the mandible must be determined first in order to form cusps that will maintain continuous contact throughout all the irregularities of mandibular movement. It is these irregularities of mandibular movement resulting from the action of the muscles and the form of the temporomandibular joints which demand the presence of cusps on teeth, and they dictate the form and position of those cusps.

Alveolar bone has a long axis just as any other bone in the body. The long axis is the architecture of bone as it was designed to hold teeth with cusps. If cusps are properly related to each other as the teeth come together, the cusps mesh and glide past each other, over the opposing marginal ridges and sulci, exerting nearly vertical pressure on the long axis of the bone. If these same cusps are not properly related to the temporoman-

1. Granger, E. R. Bio-mechanics of periodontal disease. J. Periodont. 21:18 April 1950.

dibular joint, they exert lateral pressure, not in the long axis of the bone, and so become pathologic cusps. Physiologic cusps function in harmony with both the temporomandibular joint and the long axis of the bone. The mouth cannot maintain a state of functional equilibrium with flat or so-called cuspless teeth, no matter what mechanical form, if they do not follow cusp forms and relations.

The cusps which will be harmonious for a given individual mouth are determined by the relation to each other of several factors; namely, the curve of Spee, plane of occlusion, anterior guidance, and functional movements of the temporomandibular joint. Although these same factors enter into every mouth, no two individuals are alike, so they vary for each individual. Certain factors are under the control of the operator and can be varied within limits to suit the needs of the individual. In that way cusps that will be harmonious with both the joint and supporting structures can be utilized. The joint is a fixed factor which must be accepted as it is.

When a disharmony exists between the teeth and joint, there is a constant struggle going on between the two. Usually the joint wins the battle and the periodontium is destroyed with subsequent loss of the teeth. Sometimes the teeth win the battle and the joint is injured. Occasionally they both succeed in injuring each other. Dentistry is not simply the repair of a lot of separate pieces of inert matter, but is the treatment of a dynamic living mouth.

TEMPOROMANDIBULAR JOINT

Anatomically this joint is a complex structure. Its functional relations influence the functional relations of the teeth and their supporting structures. Functional movements of the mandible that articulate the teeth on each other are executed by two separate actions which always occur simultaneously. The condyle rotates on the meniscus, and at the same time the meniscus slides on the glenoid fossa. From the standpoint of its functional relations to the teeth, within the range of tooth contact, the temporomandibular joint operates as though it were a moving ball and socket. Although anatomists do not regard this as a true ball and socket joint, nevertheless, within this limited functional range the joint of the condyle on the meniscus operates as a ball and socket and is analogous to any other ball and socket joint. The difference is that by sliding the meniscus the whole ball and socket can be moved on the fossa as a unit. Because these two actions take place simultaneously, every movement of the mandible by heavy muscular force against resistance is accompanied by translatory movements of the condyle.

REST POSITION

Although every functional movement of the mandible against resistance that requires muscular force is accomplished by these two simultaneous actions, the unstrained closure from rest position to occlusal contact is not the same. Closure from rest position involves a slight, but nevertheless important, additional translatory motion which is not a combination of these two actions.[2] It is not a masticating movement, and if the mouth is treated as though it were, it can lead to serious injury. During functional movements the mandible does not go to rest position; it drops to rest position when function has ceased. So the closure from rest position to occlusal contact involves a bodily lifting of the mandible to brace the condyle on the meniscus against the fossa preparatory to the rotational movements of the condyle on the meniscus.

This translatory movement from rest position to occlusal contact when force

2. Thompson, J. R. Concepts regarding the functioning of the stomatognathic system. In this issue.

is applied usually is slight, at most a couple of millimeters and frequently less, and usually is accompanied by a slight retrusion of the mandible. It can be of extreme importance in tooth relationship. It therefore is necessary to distinguish it from the translatory movements that take place in mandibular movements against resistance. As Thompson has pointed out, the closure from rest position is not a pure hinge movement and is not reproducible on an articulator; however, functional movements of the condyle are those of a moving hinge and are reproducible on a suitable articulator.

The closure from rest position does not have the same significance to the restorative dentist that it does to the orthodontist. To the orthodontist, closure from rest position is a guide to the relation of the entire dentition to the skull. The restorative dentist cannot use it as a means of relating teeth to each other in functional contact in centric relation. By its very nature, rest position is not a functional relation; otherwise it would not be rest position. Because of its translatory nature, if teeth are related to each other in rest position, when they come into functional contact with heavy muscular force, they will make premature contact posteriorly with resulting damage to the periodontium. Conversely, study models mounted from rest position, on closure will always show premature contact anteriorly, leading to the inevitable conclusion that the teeth are forcing some kind of a posterior displacement of the condyles. In many of these instances observation of the conditions in the mouth will show posterior premature contact causing a forward displacement of the condyle. Although there are many cases of posterior displacement, they cannot be diagnosed by mounting models in rest position and closing on a hinge articulator.

The problems of roentgenographic diagnosis and of taking a centric bite are entirely different. The limitations of the roentgenogram are such that the slight translatory shift from rest to functional bracing of the condyle can be considered as within the inherent lack of precision, because of the very nature of the roentgenographic technic. Therefore, as a means of gross diagnosis of various mandibular displacements, from a roentgenographic standpoint, it is safe to regard the closure from rest position to normal occlusal contact as a hinge closure.

Establishing the actual physical relations of the teeth is an entirely different process. Here both the hinge axis and the relations of the teeth to each other are remarkably precise. The slight translatory movement, though it may be only a millimeter, which is negligible in the roentgenogram, becomes a gross error when relating casts on an articulator. That is why, if the model relation is established by means of a bite taken at rest position, and the models then are brought to occlusal contact by closing on a hinge articulator, there will be space between the posterior teeth. Such space does not exist in the mouth when the teeth are brought into functional contact with muscular force. Such a mounting, therefore, would show premature contact anteriorly and would lead to the inevitable conclusion that the teeth are forcing some kind of a posterior displacement.

The clinical proof of this lies in two common observations. By direct examination in the mouth it frequently is possible to detect premature contacts of one or more posterior teeth that are causing lateral displacement and demonstrate the direct relationship of these premature contacts to the breakdown of the supporting structures. Yet casts of this same mouth mounted from rest position would show an entirely different contact and no apparent relationship between the premature contact and periodontal breakdown. That does not mean that all teeth in premature contact cause periodontal breakdown since such a breakdown depends on the bone metabolism. As a

matter of fact, relieving such a premature contact, which suddenly creates a completely different functional relation of all the teeth to their supporting structures without time for adaptation to changed conditions, frequently will make matters worse. That likewise is a problem of metabolism. If the metabolism is adequate, relieving the contacts may allow for eventual improvement; but if the stresses thus created are greater than the metabolism can cope with, it will lead to ultimate destruction.

It should be apparent that if the operator actually succeeds in getting a rest position bite, restorations based on such a relationship would create more posterior premature contact and make a bad matter worse. In those cases where the operator can point to successful results obtained when this procedure was used, it is a certainty that he did not actually succeed in obtaining a rest position bite. Indeed, if he succeeded in obtaining several duplicate bites, it is even more certain, because rest position is not that precise. But the closure on a true hinge axis is precise. It is not feasible to use the roentgenogram as a check to determine that the bite actually was taken in rest position.

HINGE AXIS

The mandible is capable of an infinite variety of paths of motion. One condyle may be undergoing only rotational movement while the other condyle is both rotating and gliding, or both condyles may be undergoing both rotational and gliding movements simultaneously. The infinite number of possible combinations of rotation and gliding of the two joints working simultaneously can produce a bewildering array of apparently aimless paths of motion. This has led to many erroneous conclusions about the adaptability of these joints. The joints are capable of a great variety of motions, but there is nothing sloppy or haphazard about the motions. This infinite variety of paths is the result of these two simple components—rotation of the condyle on the meniscus, and the path of the meniscus on the fossa as it moves the condyle to various positions while it is rotating.

Rotatory motion of the condyle takes place about an axis. In vertical motion this is referred to as the hinge axis; in horizontal motion it is referred to as the center of rotation. The point where these axes meet in each condyle is the axial center of motion. Since these two points are located in their respective condyles, they are constant to the mandible, so wherever the mandible moves the axial centers move with it, and they are the centers of rotatory movement in every contacting position of the teeth. Connecting these two axial centers in the condyles with an imaginary line forms the hinge axis of the mandible. The fact that the hinge axis is constant to the mandible and therefore determines the arc of closure on which the teeth meet in every contacting position is of fundamental importance. If it were merely a question of centric closure it would be relatively unimportant.

To reproduce all possible functional movements of the mandible for a given individual it is necessary to locate the axis of the condyles and to record the paths which the axis follows. The combination of all the paths of these motions can be reproduced in the conformation of the cusps and sulci of the teeth. The object of any functional treatment is to reproduce in the relation of the teeth to each other the paths of motion of the mandible as controlled by the temporomandibular joints. The object of any articulator mounting is to reproduce on a mechanical instrument the same relation of the teeth to the axis of the articulator as the teeth in the mouth occupy to the axis of the condyles. The object of an articulator setting is to reproduce the paths of motion of this axis. Merely to relate the teeth to each other by any kind

of a bite, without also relating them to the axis, means that they cannot function anywhere except in the one static position at which they were related. Since the object of the recording is to trace the path of the axis, obviously it is necessary first to locate the axis.

The path of the axis ends when the mandible reaches its most retruded position. Closure in any other position is accomplished by both rotating and moving bodily. Only in this retruded relation can the condyle make pure rotatory movements unaccompanied by gliding. Since the paths start and end in this terminal hinge relation, this is mandibular centric, or as it is commonly called, centric relation, the relation of the mandible to the skull where the teeth should meet in centric occlusion. Since it is true that the mandible does not actually function with pure rotatory movements unaccompanied by translatory motion, in order to reproduce these paths of the mandible the components of rotation and gliding must be separated. Almost all patients, when they are not required to exert great muscular force on the mandible, can execute these motions separately—that is, the rotation of the condyle on the meniscus and the gliding of the meniscus on the fossa. Of course, in gliding of the meniscus the condyle also will be rotating, but the axis will remain in fixed relation to the meniscus,[3] so if the axis has been located first, rotation of the condyle will not affect the tracing of its path.

CONDYLE PATHS

For many years it has been customary to speak of the "condyle path" and "Bennett movement" as though they were separate and distinct entities, but of course they are simply different directions of the path of the meniscus, and therefore the axis. Since they have decidedly different effects on the relation of the teeth and therefore on tooth form, however, it is convenient to refer to them by separate terms. The term "condyle path" refers to the protrusive paths of the menisci on the fossae. "Bennett movement" refers to the lateral paths of the menisci in lateral excursions of the mandible.

In protrusive movement of the mandible, both condyles and menisci glide down and forward on the slanting path of the glenoid fossa. The architecture of the bone supporting the teeth is such that in a natural dentition the cusp height increases from posterior to anterior. It is this cusp relation which creates anterior guidance of the mandible and the harmony between shearing and milling actions of the teeth.

In lateral excursion, one condyle (the balancing) moves forward, down, and inward on the glenoid fossa, and at the same time rotates on the meniscus. It is not a universal joint, incapable of direction. Its limitation of movement against the inner curbing of the glenoid fossa determines the Bennett movement. The other condyle (working, not "resting") rotates on the meniscus, and they both move outward across the fossa to the extent determined by the balancing condyle. Both condyles are rotating and gliding simultaneously, with the same type of motion as the protrusive movement, but on entirely different paths. All of the possible intermediate lateral protrusive paths are the resultant of various combinations of these two basic paths of motion. It is this lateral path across the fossa which is the Bennett movement. The mandible can execute various degrees of the Bennett movement in various lateral protrusive paths, and varying degrees of opening, or tooth contacts. It is this path which accounts for the irregularities of occlusal form to enable the cusps, required for anterior guidance, to pass each other on the working bite, without injury to the supporting structures.

3. Granger, E. R. Centric relation. J. Pros. Den. 2:160 March 1952.

The condyle path manifests itself largely in the height of the cusps that are required for functional balance. The Bennett movement determines the form and position of the sulci and marginal ridges over which these cusps pass as they glide past each other in the working bites. The Bennett movement is the power movement as the muscles on the working side contract and the cusps pass each other rotating about the axis as it glides across the fossa. The Bennett movement largely determines the direction of stress on the supporting structures and therefore whether cusps are pathological or physiological. Of all mandibular paths, the Bennett movement is by far the most important.

In mastication these are all return paths. The mandible moves into lateral excursion in the open position and returns along these paths. In bruxism, which is the most damaging influence, the paths are followed in both directions.

Since the Bennett movement is a bodily side shift of the mandible in lateral excursion, as the meniscus on the working side glides across the fossa and the meniscus on the balancing side glides down and forward, the effect is the same as though there were three different condyle paths in each joint—the path of the axis in protrusive when both condyles simultaneously move down and forward, the path when it is the so-called "balancing" condyle (a misnomer) and moves down, forward, and inward to control the Bennett movement, and the path across the fossa when it is the working condyle. The resultant path of the mandible, not only on the working but also on the balancing side, is not the same as the protrusive path. To make a protrusive record only, by whatever means, will not record the functional paths of the mandible; it will not record either the Bennett movement or the condyle path in lateral excursion. Since functional movements of the working side are the resultant of these two actions, a protrusive record alone is of dubious value. Actually such a record is capable of more potential harm than good. Cusps formed on the basis of it can easily produce rapid destruction.

If, during lateral excursion of the mandible, the condyle on the working side made a simple rotation, then the Bennett movement would not present any problem. As the condyle is rotating on the working side, however, it is also moving bodily across the fossa. The mandible is describing a path around a moving center; it is doing the same thing, but in a different direction and path, that it does when it is protruded. It is no more sensible to record the protrusive path than the lateral path, particularly when it is realized that powerful functional movements are made with the Bennett movement. Of course, to obtain any semblance of functional balance, both the protrusive and lateral paths must be recorded.

Because the axis is gliding across the fossa in lateral excursion, the notion arose that the center of rotation was not located in the condyle. It is the same type of combination movement that leads to so much misunderstanding of the hinge axis as a component of the mandibular synergy. It is true, however, that for a single repeated mandibular path an axis could be found that would be the center of the combination movement, one that was different from the hinge axis. That center, however, would be only for that one path of the mandible. Each path would require a different center.

For example, the average patient, when told to open his mouth, will open down and forward; he will use both components of motion. The mandible will describe an arc, and the center of that arc will be somewhere below and behind the condyle. If he opens and moves laterally at the same time, he will describe a different arc, and again there will be an axis below and behind the

condyle, but it will not be the same as the axis in pure protrusive opening. There will be a different axis for each different combination. That is true only because each of these paths represents a combination of movements; therefore, at first glance it would appear that there is no true single hinge axis.

Recording according to these combination movements can lead to serious error in locating the true axis. In practice the axis is located by attaching an adjustable face-bow rigidly to the mandible. As the patient opens and closes with pure rotatory motion, the stylus pin is adjusted until it reaches a place opposite the condyle where the point remains stationary as the condyle is rotating. But if in locating this axis, one side were rotating while the other was both rotating and making a slight glide of the meniscus, the rotating side would be working on the true axis, while the point on the other side would be on a false axis, or combination axis. This would lead immediately to two commonly held fallacies: first, that there are two separate condylar axes; second, and more important, since closure in this action involves bodily movement of the condyles, it would lead to the completely erroneous conclusion that the Bennett movement is a component of the terminal closing motion of the condyle. Since it would cause a gross deviation of the mandible from its true closing action, it would lead to gross errors in the recording of the length of the ramus on one side which would be reflected in any articulator mounting made from such a recording. Simple geometry shows that a rigid body cannot revolve around two axes simultaneously. In order to have two condylar axes the mandible would have to bend every time it moved.

This same error in locating the axis leads to another popular misconception. Since the meniscus on one side is making a slight protrusive movement while the condyle on the other side is rotating, if a mounting were made from such a false axis the mandible would appear to be capable of further retrusion. This would lead to considerable lateral deviation of the mandible and strengthen the fallacy that the Bennett movement is a component of the closing phase.

This path of motion, which is erroneously used to locate the axis, is the same pattern as the chewing stroke after the teeth come into contact. Many people are habitual one-sided chewers; therefore, this pattern of motion becomes a fixed neuromuscular action which sometimes is difficult to overcome when locating the axis and obtaining a centric bite. Indeed, with some unilateral chewers it becomes such a fixed habit that they will not make both lateral excursions without considerable practice.

The importance of this factor cannot be overlooked. An error in locating the axis may lead to many unnecessary problems in treatment. A great deal of misleading information has been published regarding the problem of locating the axis. This has served to confuse rather than clarify this fundamental problem of dental practice.

The teeth which will actually function in any given mouth depend on a number of factors, all of which, interdependent on each other, comprise the synergy of oral physiology. The success of the entire treatment depends on the correct orientation of the teeth to each other and to the hinge axis. Functional movements of the mandible start and end in centric relation—that is, the terminal hinge relation. So, correct orientation of the teeth in centric occlusion depends on two factors—the teeth must be related properly to the hinge axis, and this relationship must be established with the teeth oriented to each other in the most retruded position of the mandible. Since the axis is located in the condyles, wherever the mandible moves, the axis moves with it. The axis determines the arc of closure on which the teeth will meet in

every contacting position of the mandible. Therefore, the first objective of any restorative treatment must be to establish the correct relation of all the teeth to the hinge axis, so that they can meet in equal simultaneous contact in every functioning position of tooth contact.

Since the path from physiologic rest to functional hinge relation usually involves a slight, but nevertheless important, translatory movement, it is imperative that the centric relationship be established with the hinge axis in its actual functional relation to the skull. Some condyles drop into physiologic rest the instant functional contact is released; others will take a varying length of time. In any case, the operator cannot depend on a static bite; the relationship must be established with the mandible swinging on the hinge axis in pure rotational motion, in the most retruded relation of the mandible. There is no single material or method which is best for all cases. Various materials are suitable to meet varying circumstances; wax, zinc oxide paste, artificial stone, self-curing acrylic resin, and various combinations of these are all useful at times. Regardless of which material is used, the relationship must be established by repeated closures into the bite with the hinge axis in the same position it will be when the teeth are brought together with muscular force against resistance.

TOOTH CONTACTS

Whether teeth come into contact during mastication is debatable, but the question is relatively insignificant as it relates to the health of the supporting structures. In many cases of malocclusion the relationship of the teeth to the axis makes it impossible for the teeth to interdigitate in mastication. It is the repeated tooth contacts during nonmasticating movements which cause most of the damage. Here the teeth meet in forceful contact. If they are not properly related to the axis, the conflict creates lateral forces which are transmitted to the supporting structures in the direction which they are least equipped to resist, instead of in the vertical thrust of normal relationship. The ability of these tissues to resist these stresses, or this excessive functional demand, depends on their metabolism. If the metabolism is equal to the task, the teeth simply will wear out; if it is not adequate, the supporting structures will be destroyed. Sometimes both processes will go on simultaneously.

Teeth wear with age, and no doubt there are certain adaptive changes which take place as wear slowly progresses, to compensate for that wear. In any case the worn teeth would not be present in the mouth were it not for the fact that the bone metabolism is able to maintain itself. Worn flat teeth create greater functional demands than properly articulated cusps. There are some people in whom wear has not produced retrogression and a lot of people in whom wear has been destructive. So wear of teeth *per se* is not necessarily a healthy process.

The slow wearing of teeth by attrition, accompanied by adaptive changes which to some extent compensate, is not the same as literally wearing out the teeth rapidly by haphazard tooth grinding. Intelligent grinding does not wear out teeth; it attempts to create normal cusp functional relation. Its greatest limitation lies in the lack of tooth structure where frequently it is needed. At best it can convert an acute process into a chronic one. Frequently it ends by creating a more destructive process than originally existed.

RECONSTRUCTION TO FACILITATE FUNCTION

Properly executed, reconstruction is the method of choice; improperly executed, it is worse than no treatment at all. The majority of people cannot have reconstruction; yet the majority do have some

functional imbalances which require treatment. The majority then require some kind of compromise, but it should be an intelligent compromise based on an understanding of the temporomandibular joint and the functional requirements of the teeth. The function of the mouth demands cusps on the teeth in precise relation to each other, but that cannot be determined by observation in the mouth alone. Furthermore, an operator must be able, by proper diagnosis, to determine in which mouths an intelligent compromise can be of real benefit and those in which complete reconstruction will be the only help. Still other instances can be helped by a combination of grinding and building.

All of these considerations demand a set of study models mounted on a suitable articulator in the same functional relation that the teeth in the mouth bear to each other, from which an adequate diagnosis can be made before undertaking any treatment. Since the relation of the teeth to the temporomandibular joint determines the functional relation of the teeth to each other, any mounting which fails to incorporate this relationship will not yield information of practical value. To undertake any treatment without first establishing the required functional relations is incompatible with dentistry as a treatment for a sick mouth.

SUMMARY

The functional relations of the teeth to their supporting structures is one of the determining factors in the metabolism of these structures. These functional relations are also influenced by the degree of harmony between the occlusal forms of the teeth and functional movements of the temporomandibular joint. The muscles of mastication provide the means of mandibular movements, but the joints determine the paths of motion. The irregularities of mandibular paths require the form of cusps to maintain equal simultaneous contact between the teeth in all excursions, with forces directed in the long axis of the bone as determined by its architecture.

A healthy arrangement of teeth thus requires that the form of the cusps be in harmony with the supporting structures, and the functional movements of the cusps be in harmony with the functional relations of the temporomandibular joint. In nature this harmony between the supporting structures and the temporomandibular joint is achieved by the form and position of the occlusal curve, so that man, the omnivorous animal, can combine the shearing and milling actions without injury and maintain them within metabolic limits.

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Characteristics of functionally optimal occlusion and principles of occlusal rehabilitation

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A general aim of modern dental science is to maintain and restore correct function of the masticatory system. Correct function signifies that the system will perform the function for which it is intended and in such a way as to place no unnecessary strain on its integral parts.

Herein are contained two basic considerations: (1) The masticatory system is a unitary system, each part of which—the teeth, for instance—must be considered in relation to the whole. (2) The masticatory system is a functional system, the prime object of which is to promote perfect conditions functionally rather than morphologically.

Dental treatment is usually not applied directly to such structures as muscles or the temporomandibular joint but to the teeth and to their conditions of contact; that is, to the occlusion. The general aim therefore may be referred to as functionally optimal occlusion. This term signifies occlusion that is in functional harmony with the whole masticatory system, comprising the supporting tissues, the facial skeleton, the muscles and the temporomandibular joints—occlusion that ensures efficient functioning without placing undue strain on the integral structures. The term rehabilitation of the occlusion covers all forms of correction and restoration of the adult dentition to this end.

Functionally optimal occlusion must be distinguished from normal occlusion. Anatomically "normal" occlusion in the sense of a specific arrangement of the teeth and specific intercuspation may constitute, but is not synonymous with, good function. Occlusion may vary considerably from this normal and yet conform to the requirements of good function. Conversely, occlusion may closely approximate the anatomic normal without affording good function. Anatomically normal occlusion cannot, therefore, be postulated as a basis of evaluation or as an aim of treatment. Neither can the basis be the morphologic averages, which are based on mathematical calculation of mean values as, for instance, in Monson's[1] spherical theory. There is no specific pattern which can serve as a general basis for the appraisal of the individual occlusion. Every case presents its own characteristics, and its treatment must be directed toward the attainment of the best functional conditions for that case.

With the research in the various fields as a basis, it is, however, possible to deduce certain requirements or characteristics of functionally optimal occlusion, although many gaps remain in our knowledge where there is ample scope for research and many fields still call for intensified study. Nevertheless, by collating the established characteristics, it is possi-

Presented in the postgraduate course "Analysis and Treatment of the Stomatognathic System," Chicago, Northwestern University Dental School, April 1-3, 1953.

1. Monson, G. S. Some important factors which influence occlusion. J.A.D.A. 9:498 June 1922.

ble to form a fairly good concept of what constitutes optimal occlusion. It is important to have a clear picture of optimal occlusion as a basis of evaluation or as a goal for treatment. As a result of hazy concepts of optimal occlusion, many dentitions are allowed to remain unimproved under the very eyes of the dentist; and those restorations that are provided lead all too frequently to dysfunction and consequent breakdown of the dentition.

The establishment of optimal occlusion is a problem of concern to many widely different branches of odontology. The purpose of this article is to set forth some of the requirements and characteristics of the form (pattern) of optimal occlusion, especially with regard to stress on the supporting tissues. These requirements will form the basis of the principles of rehabilitation.

Certain of these characteristics and principles are already recognized and require only a brief review; others require clarification.

STRESS ON THE INDIVIDUAL TOOTH

The investigations on the reaction of the supporting tissues to the load on a single tooth are of primary importance. Present knowledge is based on general studies of the structure of the supporting tissues. A stress to which a tooth is subjected acts as a stimulus to this structure. It may be regarded as a force radiating from the tooth via the cementum, the periodontal membrane and the cortical plate to the supporting bone. The subordinate structures adapt themselves to the force.

In the bone, which is architecturally a trabecular tissue, the trabeculae are adapted in number and direction to the functional requirements. Benninghoff,[2] Seipel,[3] and Weinmann and Sicher[4] have demonstrated that a change in the function, an increase in the load or a change in the direction of the force leads to changes in the structure. Increased function, within certain limits, multiplies and strengthens the trabeculae. Reduced function has the opposite effect. Both excessive and insufficient functional usage have unfavorable effects. There is thus a functional optimum. Accordingly, a tooth should be subjected to a certain occlusal load and should not be permanently without one; that is, it should always have an antagonist.

The reaction of the periodontal membrane is of particular interest. The tooth is suspended in collagenous fibers. Gottlieb and Orban[5] and others have shown that under longitudinal axial stress practically all the fibers resist the load and produce traction on the bone, which stimulates bone apposition. The alveolar bone and the fibers jointly sustain the load. When lateral stress is acting, the force is taken up regionally. As a result only some fibers produce traction, regions of pressure are formed, and bone resorption results. The supporting tissues thus resist axial stress much better than lateral stress.

According to Box[6] and Breitner[7] it is not the magnitude but the direction of the force that is decisive. In normal mastication a force in the axial direction can hardly be too great; it is necessary that it should exceed a certain minimum in order to maintain the supporting tissues in a healthy condition. The unfavorable effect of lateral stress is governed, in addition, by the frequency of application of the force and the period over which it acts.

For the pattern of the occlusal surface,

2. Benninghoff, A. Die Architektur der Kiefer und ihrer Weichteilbedeckung. Paradentium 3:50, 1934.

3. Seipel, C. M. Trajectories of the jaws. Acta odont. Scandinav. 8:81 June 1948.

4. Weinmann, J. P., and Sicher, Harry. Bone and bones. St. Louis, C. V. Mosby Co., 1947.

5. Gottlieb, Bernhard, and Orban, Balint. Die Veränderungen der Gewebe bei übermässiger Beanspruchung der Zähne. Leipzig, Georg Thieme, 1931.

6. Box, H. K. Twelve periodontal studies. Toronto, University of Toronto Press, 1940.

7. Breitner, Carl. Alteration of occlusal relations induced by experimental procedure. Am. J. Orthodont. & Oral Surg. 29:277 May 1943.

the direction of the force is the essential factor. Purely axial and purely lateral stresses occur but seldom. The variations in the inclination of the axis and the shape of the crown give rise to complex stresses. Generally, the more the force deviates from the direction of the long axis, the less satisfactorily do the supporting tissues resist that force.

The architecture of the bone and the condition of the supporting tissues in general are determined not only by function but by systemic factors, such as metabolism, nutrition, vitamin level and hormonal balance. The state of the supporting tissues is further influenced by local irritational factors. As a consequence, the condition of the supporting tissues is determined by the combined effect of all these factors. The occlusal load, in the form for instance of a lateral force, may therefore not in itself be said to be "detrimental" or "traumatic." The terms "favorable" and "unfavorable" are more appropriate. Optimal occlusion from the point of view of stress may be expressed as occlusion that is best calculated to obviate periodontal destruction.

For functionally optimal occlusion, the teeth should receive stress consistent with physiologic requirements for stimulation of the supporting tissues; and, in particular, the direction of stress should coincide as closely as possible with the long axis of the tooth. This principle is the principle of axial stress.

STRESSES ON THE DENTITION

A stress that may seem unfavorable for the individual tooth and its supporting tissues may not, in fact, be so, since the tooth must be considered in relation to the larger system, the dentition. When the teeth are in interproximal contact, the lateral stress is distributed in a mesiodistal direction to the adjacent teeth. Since the dental arch changes in direction at the cuspids, this distribution is particularly operative within each of the three tooth groups comprising the cuspids and incisors in the anterior segment and the cuspids, bicuspids and molars in each lateral segment. Functionally, the cuspid should be included in both the anterior and the lateral segments. An interproximal contact therefore is essential. The lateral forces which act on the teeth in radial and transverse directions are not distributed in this manner and are therefore more unfavorable.

The distribution of the total load in such a manner that many teeth make simultaneous occlusal contact has long been considered beneficial for the individual tooth and its supporting tissues. Distribution of occlusal stress is, generally speaking, a desirable characteristic.

It is logical that in centric position the total load should be distributed over all parts of the dental arch and thus over all the teeth. The load is potentially the greatest in centric position.

In eccentric positions the load should be distributed primarily over all the teeth in the engaged segment, since in function only one group of teeth comes into use at a time. In a dentition with no large gaps, a force applied in incision is exerted only on the anterior teeth and is not transferred to the lateral segments.[8,9] There seems to be no reduction in the load on the anterior segment through simultaneous use of bicuspids and molars. In mastication the force is applied mainly on the side where the bolus is placed, that is, on the working side. Even when food is finely divided or when there is no food, the load seems to be applied similarly, mainly on one side at a time. The real significance of stress distribution in eccentric positions and its extent will be discussed later.

For functionally optimal occlusion the total load should be distributed through

8. Schuyler, C. H. Factors of occlusion applicable to restorative dentistry. J. Pros. Den. 3:772 Nov. 1953.

9. Jankelson, Bernard; Hoffman, G. M., and Hendron, J. A. The physiology of the stomatognathic system. J.A.D.A. 46:375 April 1953.

interproximal contact and by simultaneous occlusal contact, in centric position among all teeth and in eccentric position primarily among the teeth in the engaged tooth segment. This principle is the principle of the distribution of stresses.

OCCLUSION IN CENTRIC CLOSURE

Axial stress and distribution of stresses are two fundamental requirements that have long been recognized. This concept, however, is one of static occlusion and is therefore insufficient. The concept must be one of functional occlusion, conforming to a dynamic pattern of the mandibular movements and hence to the structure of the whole masticatory system.

The first criterion of occlusion is closure in centric relation. Centric relation is a mandibulocranial relation and is understood to imply a harmonious state of the temporomandibular joints and the musculature and of the relation between them.

The stress on the teeth should be studied primarily in centric relation and not in the intercuspal position; that is, the position of the mandible determined by the interdigitation of the cusps and the inclined planes of the teeth. On closure in centric relation it occasionally happens that some cusps or inclines make premature contact, after which the mandible slides into an "incorrect" intercuspal position, where several teeth make contact.

There are various concepts of what centric relation implies and the manner in which it can be obtained. A discussion of centric relation as the "ideal" relation therefore is indicated. A knowledge of centric relation is of great importance, since direct observation of occlusal contacts in the mouth is often unreliable and should be supplemented by an examination of casts on an articulator. A record of centric relation is necessary.

A clearer view of centric relation may be obtained from the study of the various

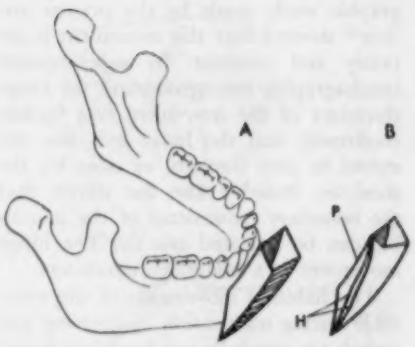

Fig. 1 • A, three-dimensional range of incisive movement of lower incisors; B, median section through A. All boundary movements, of which posterior hinge movement, P, is one, can be repeated exactly. Habitual movements, H, occur within range of movement and have a varying course even in the individual

opening and closing movements of the mandible. It is instructive to follow the movements performed by the incisal point of the lower incisor. Mandibular movements are governed by the occlusal surfaces of the teeth, by the muscles and by the shape of the joint and its capsular ligament. If the extreme movements are recorded graphically, a characteristic figure is obtained. In the horizontal plane this figure is a rhomboid; by including the opening movements, a three-dimensional figure is described (Fig. 1,A).

Of special interest is the most retruded opening and closing movement. This movement is indicated by the posterior margin of the three-dimensional range of movement and is best studied in a sagittal section (Fig. 1, 2). That the first part of an opening and closing movement, with the mandible voluntarily retruded, is a "hinge movement" has been demonstrated by Fischer[10] and McCollum.[11] A

10. Fischer, R. Die Öffnungsbewegungen des Unterkiefers und ihre Wiedergabe am Artikulator. Schweiz. Monatschr. Zahnheilk. 45:867 Oct. 1935.

11. McCollum, B. B. Fundamentals involved in prescribing restorative dental remedies. D. Items Interest 61:522 June 1939.

graphic study made by the present author[12] showed that this movement is rotatory and constant. By superimposed laminagraphic roentgenograms the hinge character of the movement was further confirmed, and the hinge axis was observed to pass through, or close to, the condyles. Posselt[13] also has shown that the boundary movements of the mandible can be repeated exactly. The hinge movement is a boundary movement.

The habitual movements of the mandible during mastication, swallowing and speech are generally not boundary movements but occur within the range of movement (Fig. 1,B and Fig. 2). The habitual opening and closing movement has a varying path even in the individual.[14,14]

McCollum,[11] Granger[15] and others consider that the basic position for diagnosis and rehabilitation is reached at the correct vertical dimension by hinge closure in the retruded relation (Fig. 2). They call this centric position. Since this position is assumed in a boundary movement, it may be repeated exactly, a factor which is of immense value. According to Posselt[13] this position is, on an average, 1.25 mm. distal to the intercuspal position, with rather wide variation. Since the position is an intentionally retruded position, however, it would not appear to involve a harmonious state of the muscles and the temporomandibular joint. In the retruded position occasionally the total load may be carried entirely by only a few teeth in the posterior region; this condition results in unfavorable loading of these teeth. It seems desirable, then, from the point of view of stress, to register the retruded position and to distribute the load, in this position, too, over a greater number of teeth.

The rest position, "the position the mandible assumes in rest in a tonal contraction of the musculature without outside interference," has been conceived by Thompson[16] and others as the primary and fundamental position. The centric position is obtained after rotatory closure through an adequate interocclusal space, on an average 3 mm. A weakness in this concept and method of determining centric position is that the path of closure from the rest position to occlusion is translatory and seldom a rotation.[13,17,18] Translatory movement seems natural in view of the character of the opening and closing movements. The rest position lies in the upper distal range of movement but is not a boundary position (Fig. 2). For this reason the closure from the rest position is a habitual movement and is subject to the same individual variation as other such movements. Consequently, to accept the actual rest position for finding the centric position seems inadvisable.

Nevertheless, the basic idea of a relaxed state of the musculature and unstrained joints that underlies the concept of rest position is the same as that which underlies the concept of centric relation. The best initial position for obtaining centric position, however, would appear to be with the teeth in closer contact than they are in the rest position.

The clinical procedure employed by the author is as follows: The patient, sitting in an upright position with the head approximately in the Frankfort horizontal plane, is asked to open and close the mouth repeatedly, completely relaxing the muscles while doing so. This action is facilitated by swallowing or by moistening the lips. While executing the

12. Beyron, H. L. Orienteringsproblem vid protetiska rekonstruktioner och bettstudier. Svensk. Tandl.-Tidskr. 35:1 Feb. 1942.

13. Posselt, U. Studies in the mobility of the human mandible. Acta odont. Scandinav. 10 (Suppl. 10) 1952.

14. Posselt, U. Underkaebebevaegelser og tandartikulation. Nord. Med.-Odont. Handbok, 1953, p. 861.

15. Granger, E. R. Bio-mechanics of periodontal disease. J. Periodont. 21:98 April 1950.

16. Thompson, J. R. The rest position of the mandible and its significance to dental science. J.A.D.A. 33:151 Feb. 1946.

17. Boman, V. R. A roentgenographic study of the position of the mandible in normal occlusion of the teeth. Thesis, Northwestern University Dental School, 1948.

18. Thörne, H. Teleröntgencephalometrisk profilanalys: systemöversikt diagram för Downs system samt mätmethod för "path of closure." Svensk. Tandl.-Tidskr. 44:30 Feb. 1951.

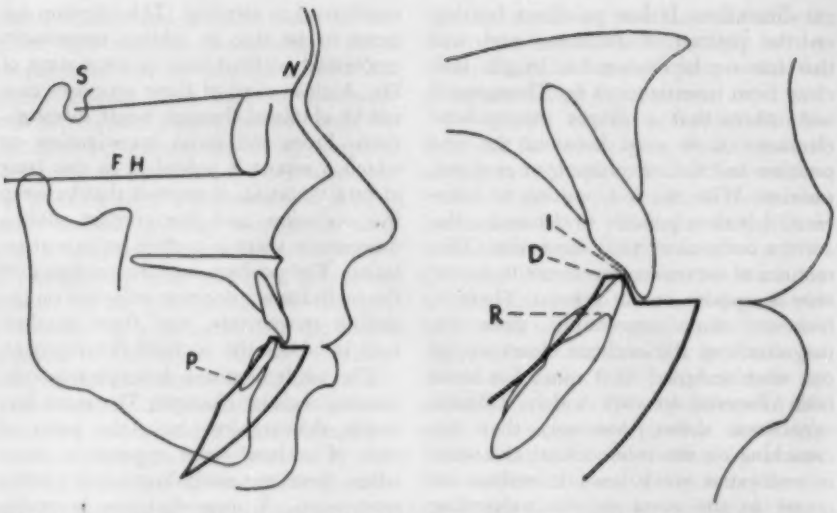

Fig. 2 • Left: Heavy-lined contour indicating range of incisive movement, in median plane, of lower incisors. Upper posterior boundary line, P, indicates posterior hinge movement. Right: Enlargement of detail on left. From intercuspal position, I, mandible may in most cases be moved somewhat obliquely backward and downward to retruded contact position, D. The rest position, R, lies in upper distal range of movement

relaxed opening and closing movement, the patient is instructed to let the teeth occlude very lightly, to stop the occlusion at the initial contact and to hold the position without any sliding of the teeth. Examination then may reveal closure into the intercuspal position—the intercuspal position coinciding with centric relation—or it may show that some cusps or inclines make premature contact, after which the mandible slides into an "incorrect" intercuspal position.

In actual registration, a position should be recorded that is close to the occlusal position, but without the cusps' making guiding contact and directing the mandible. The closing movement to tooth contact is practically a rotation, the distance being so small that any deviation from this is negligible. Though this procedure for obtaining centric is not infallible, it appears to be the best procedure for providing the ideal position understood by centric position.

As it has already been pointed out, occasionally it happens that only a few teeth make contact on closure into centric position. In that case, the load on the teeth in premature contact and the sliding of the mandible into a forced position produce stresses unfavorable to the supporting tissues of the teeth and probably at the same time disturb the temporomandibular joint.

For functionally optimal occlusion, the mandible on closing in centric relation should close without interference into the position where cusps and inclined planes interdigitate, that is, into the intercuspal position. This principle is the principle of closure without interference in centric maxillomandibular relation.

OCCLUSAL VERTICAL DIMENSION

Closely related to occlusion in centric position is the problem of occlusal verti-

cal dimension. It has no direct bearing on the pattern of occlusion and will therefore not be discussed at length. It is clear from investigations by Thompson[16] and others that a proper interocclusal clearance must exist between the rest position and the intercuspal, or occlusal, position. With the rest position as reference, it is then possible to determine the correct occlusal vertical dimension. This manner of determination seems to be the only acceptable one at present. There is, however, some uncertainty, since the magnitude of the occlusal clearance, at one time accepted as 3 mm., has since been observed to vary widely. Clinical experience shows, however, that encroaching on the interocclusal clearance in restorative work leads to serious increase in the stress on the supporting tissues, as the musculature attempts to recover the individual's original interocclusal clearance. An unfavorable leverage also is introduced, since the clinical crown becomes too high in relation to the clinical root.

For functionally optimal occlusion, the occlusal vertical dimension should be determined by proper interocclusal clearance between the rest position and the intercuspal position, or occlusion. This principle is the principle of proper interocclusal clearance.

OCCLUSION IN EXCURSIVE MOVEMENTS

The occlusion must conform also to excursive gliding movements with the teeth in contact. This principle is for the most part generally accepted.

Some workers, including Kurth,[19] Jankelson and others,[9] maintain that contact gliding movements do not occur in mastication and hence that excursive movements are not concerned in occlusion. Jankelson's studies pertain only to movements in mastication. There is clinical evidence, however, that most dentitions present some signs of excursive movements such as attrition. This attrition appears to be due to gliding movements performed without food at some stage of life. A clear view of these processes cannot be obtained through single investigations. From the serial investigation on which a report is published in this issue of THE JOURNAL, it appears that between the occlusion and the contact gliding movements there is a close reciprocal relation. The position and the occlusion of the teeth have a decisive influence on the gliding movements, and these in their turn influence the occlusal development.

The adult dentition is subject to continuous occlusal changes. The most favorable development from the point of view of occlusal stress appears to occur when there are multidirectional gliding movements. A somewhat less favorable form of occlusion will result when bilateral movements predominate. When solely unilateral movements predominate, the development is unfavorable.

Knowledge concerning the form of occlusion that permits free gliding movements is of great importance. Gliding movements occur from the position where several teeth are in contact and the inclination of the gliding path is fairly flat. Accordingly, the pattern of optimal occlusion requires simultaneous contact in eccentric positions between teeth in the engaged segment and gliding paths towards centric position, that are flat or moderately steep.

A form of occlusion permitting multidirectional gliding movements is the best. A steep incisal guidance with few teeth making contact in the protrusive position is a common condition, and in such cases bilateral movements will predominate. It is, then, of importance to note that dentitions with a bilateral movement pattern have a development which is relatively favorable.

In treatment the steepness of the in-

19. Kurth, L. E. Mandibular movements in mastication. J.A.D.A. 29:1769 Oct. 1942.

cisal guidance can in most cases be reduced but slightly. Nevertheless, in a considerable number of cases a fairly flat lateral gliding path and simultaneous occlusal contact among several teeth in the lateral segment, involving cuspids, bicuspids and molars, may be obtained on the working side, a situation which promotes lateral gliding movements and thus a relatively favorable development. It has already been said that balancing contact on the unengaged side does not contribute to a reduction in the stress applied to the teeth on the working side. In this connection the danger of excessive contact of balancing cusp inclines should be emphasized, since such contact obstructs gliding movements.

The inclination of the gliding paths and the number of teeth in contact that will permit free gliding movements vary with the individual. Young persons seem to perform gliding movements with relatively steep paths and with few teeth in contact. For the execution of the gliding movements, it is not necessary for all teeth in a segment to make contact and for the gliding paths to be completely flat. What is essential is to have sufficient teeth in contact and a sufficiently flat gliding path to promote gliding movements. The establishment of this situation is the real function of the simultaneous occlusal contact in the engaged tooth segment in eccentric positions.

In correction by grinding, often only a small increase in the number of teeth in contact and a slight reduction in the inclination of the paths need be made to render lateral gliding movements possible. In the case of young persons, in particular, only minor alterations are necessary. The aim in correction is to guide the occlusion into beneficial development. Great reduction in the cuspal inclination and incisal guidance is rarely indicated. Malposition, resulting from development or extraction, often leads to a condition in which there are steep gliding paths and few teeth in occlusal contact in eccentric positions. Treatment then must be directed primarily to the correction of the malposition; orthodontic measures may be of value.

No specific cuspal inclination can be indicated for the shaping of the occlusal surface in restoration. Individual restorations should be in harmony with the inclinations of the remaining teeth; these inclinations have often been obtained by grinding. When restorations are made for all bicuspids and molars, harmony should be created with the guiding factors: incisal guidance and condylar guidance. At the same time, the aim should be to make the cusps as flat as possible. To this end, it is sometimes possible to modify the inclination of the occlusal plane and the compensating curve. Occasionally the guiding factors make it necessary to form exceptionally steep cusps in order to obtain multiple contacts, especially balancing contact. In such cases it is better to make the cusps more shallow even if it is necessary to have fewer teeth in contact. The advantage of extensive stress distribution is counteracted by the less favorable direction of stress and the obstruction of free gliding movements.

For functionally optimal occlusion, excursive movements with the teeth in contact, especially lateral gliding, should be made without interference. The establishment of this objective is facilitated by flat gliding paths and simultaneous contact in eccentric positions between several teeth in the engaged tooth segment. This principle is the principle of free gliding movements, especially lateral movements.

SUMMARY AND CONCLUSIONS

Functionally optimal occlusion is occlusion in functional harmony with the integral parts of the masticatory system. It ensures efficient functioning without placing undue strain on the integral parts. In particular, the occlusion should be favorable to the supporting tissues of the teeth. There is no specific pattern of

functionally optimal occlusion which may serve as a general basis for the appraisal of the individual case. Functionally optimal occlusion may vary considerably in pattern.

It is, however, possible to deduce from research in various fields certain characteristics of functionally optimal occlusion, with particular regard to occlusal stress. These characteristics will provide the basis for the principles of rehabilitation. The main characteristics and principles which have been determined are:

1. Stress. The teeth should receive stress consistent with physiologic requirements for the stimulation of the supporting tissues. Axial stress, that is, the direction of stress on the individual tooth, should coincide as closely as possible with the long axis of the tooth.

2. Distribution of stresses. The total load should be distributed by interproximal tooth contact and by simultaneous occlusal contact in centric position among all teeth and in eccentric positions primarily among the teeth in the engaged tooth segment.

3. Closure without interference in centric maxillomandibular relation. The mandible on closing in centric relation should close into the position where cusps and inclined planes interdigitate without interference, that is, the intercuspal position.

4. Proper interocclusal clearance. The occlusal vertical dimension should be determined by proper interocclusal clearance between the rest position and the intercuspal position.

5. Free gliding movements. Excursive movements with the teeth in contact, especially in lateral gliding, should be made without interference. The attainment of this objective is facilitated by flat gliding paths and simultaneous contact in eccentric positions among several teeth in the engaged tooth segment.

By collating these characteristics and principles, it is possible to form a clear concept of what constitutes optimal occlusion. First, with these characteristics as a basis, it is possible to evaluate the occlusion of an individual. Secondly, by conducting the treatment according to these principles of rehabilitation, the best functional conditions for the dentition of the individual can be realized.

Norrmalmstorg 1

The Electricity of Viruses • How viruses attach themselves to the wall of a bacterium before they invade is a question that greatly interests virologists. Theodore Puck and Bernard Saglik, biophysicists at the University of Colorado, have performed an ingenious experiment which supports the idea that it is a simple electrical process.

The targets for the viruses in their experiment were not living bacteria but ion exchange resins. It has been known that bacterial viruses attach themselves to cells only when positive ions are present. This suggested that both viruses and cells normally are negatively charged, and that the positive ions make it possible for them to get together by neutralizing the repulsive force of the like charges. The Colorado experimenters found that viruses readily attached themselves to positive resins, and would not stick to negative resins unless positive ions were added. They proved that cells, like viruses, also are negative: they attach to positive but not to negative exchangers.

When certain bacterial viruses attach to a resin, they begin at once to separate into a protein and a nucleic acid fraction. This parallels exactly their behavior in cells, where the nucleic acid is injected into the cell and the protein "coat" remains outside. Puck and Saglik, writing in *The Journal of Experimental Medicine*, suggest that the splitting is the result of simple electrostatic forces. *Science and the Citizen. Scientific American 189:44 August 1953.*

The value of bite analysis

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Bite analysis is, briefly, an examination of the human bite with reference to articulation and stress. Such an analysis should precede any attempt to restore or reconstruct an individual dentition. Naturally, all other factors associated with the functional efficiency of the bite must be taken into account also, such as incidence of caries, oral hygiene, condition of the gingiva, nature of the saliva, frequency and distribution of calculus, formation of pockets, suppuration, type of bite, and so on.

The correct understanding of what constitutes "bite analysis" and the application of this understanding in dental practice is a complete change in the conception of the task of the dentist. The old view that the chief function of a dentist was to carry out local treatment of an isolated tooth or defect in the dentition—accepting and adapting his work to the existing oral conditions—has had to be abandoned.

The modern dentist must approach his task with the conviction that the final aim of all dental treatment should be to make the bite function as harmoniously as possible. The correction of details then will be completely subordinated to the main mission; namely, restoration of the ideal function of mastication.

These views were first propounded in America between 1916 and 1926 by such men as P. R. Stillman, H. O. McCall, H. K. Box, F. A. Bricker, W. H. Wright, F. H. Orton, C. H. Schuyler and others in their articles on the importance of balanced occlusion. To understand the term "bite analysis," a definition of "balanced occlusion," or, as I prefer to call it, "balanced articulation" is necessary.

The term "balanced occlusion," or "balanced articulation," originally was associated with a technical operation in the construction of complete dentures. It has come, however, to be a collective designation for the physiologic function of the bite. Occlusion is the contact between cusps and cuspal planes of the teeth in the upper and lower jaws when they meet in biting position (static condition). Articulation, on the other hand, denotes this contact during the functional movement of mastication (dynamic condition). In both cases there may be normal, traumatic, centric, eccentric, unbalanced or balanced positions or movements.

In speaking today about "balanced articulation," the reference usually is to the natural bite, and the designation is used as a collective term for the various forces that will be exerted on the jaws, alveolar processes and the teeth and their supporting tissues during physiologic mastication and swallowing movements. By balanced articulation is meant an ideal state of equilibrium during these movements so that all teeth will be as uniformly stressed as possible.

These ideas led to an overestimation of the influence of "traumatic occlusion."

Presented in the postgraduate course, "Analysis and Treatment of the Stomatognathic System," Chicago, Northwestern University Dental School, April 1-3, 1953.

Undoubtedly overstrain on an individual tooth may exceed the margin of safety optimal for that tooth, in which case the attachment of the tooth in its alveolus will be destroyed, the tooth will become loose and eventually will be exfoliated. Today, however, it is recognized that this is not the only explanation of periodontal disease; some other factor must be present, though what that factor, or factors, is has not been fully determined. There must be a certain predisposition toward this disease in some individuals, families and races. During the past 20 years, clinical experience as well as experimental research and histological investigations has shown that overstrain on an individual tooth or group of teeth that results from lack of balance in articulation during masticatory movements of the jaws may be the releasing and precipitating cause of the disease, and that unless this overstrain is corrected, local methods of treatment will not be successful.

Parallel with this development of ideas, the attempts to perfect an articulator capable of reproducing the complicated movements of the human jaws, as well as a method of registering the individual condylar path, have been crowned with success through the efforts of such men as Bonwill, Gysi and Hanau, and of later investigators such as McCollum, Stansbery and others.

Thus, through a deeper knowledge of the problems of articulation as related to complete dentures, and the transference of this knowledge to the study of the natural bite and its function, a major advance has been made. Some authors, it is true, have denied the possibility of making an analogy between the laws of denture articulation and those of the natural bite, on the grounds that such an ideal equilibrium of articulation only occurs in rare instances in civilized man, and that a bilateral articulatory balance, which is necessary for the stabilization of a complete denture, does not exist in the natural bite. Although this view is correct in principle, it nevertheless is an indisputable fact that the distribution of stress between individual teeth will be achieved best if the laws of articulation as formulated by Hanau are observed as closely as possible. In order that this shall be accomplished, it is necessary to bring the overbite, the height of the cusps and the compensatory curve into harmony with the individual's condylar path and with the laws of articulation. By this means the most favorable conditions for the periodontium will have been created which in turn will help the weakened attachments of the tooth to withstand the stress associated with mastication in a person who has a predisposition toward periodontal disease.

In the light of these laws of articulation it is easier to understand that complete articulatory equilibrium will occur only (1) when the vertical dimension (usually called the height of the bite) is correct; (2) when the incisal overbite and the overjet are correct; (3) when the occlusal details of the teeth of one jaw are in full harmony with those of the opposite jaw, both in a position of rest and during masticatory movements; and (4) when the two condyles lie and move symmetrically in their respective fossae.

It also will be readily understood that if, through the loss of one or more teeth, an irregularity has been created in the occlusal curves, and the occlusal surfaces tend to guide the mandible in other paths than are allowed by the paths of the joints, one of the following possibilities will occur.

1. The tooth or teeth with premature or interfering contacts will impede the movement of the jaws, and overload them as a result of the unilateral stress. If this overloading exceeds the margin of safety of the periodontium, or if the resistance of the periodontium is lowered by a predisposition toward periodontal disease, the result will be a breaking down of the periodontal membrane and eventual loss of the teeth involved. If, on the other

hand, the stress does not exceed the safety margin of the periodontium, the reparative power of the body will be capable of strengthening the periodontal membrane.

2. Any existing incongruity between the way the lower jaw tends to be directed by the temporomandibular joint itself and by individual teeth may cause disturbances in the articular function that are usually called "temporomandibular arthroses." In such cases, too, a certain predisposition in addition to the functional disturbances seems to be necessary for the development of the disease.

3. The third and most desirable possibility is that none of these diseases will occur.

Another logical corollary from this reasoning is that the human mouth is not the best articulator. To clarify this statement, it should be pointed out that when the teeth are closing in centric occlusion, the lower jaw may be directed into a false position because of the presence of an impediment.[1] I have called this position "habitual centric occlusion." It is made possible by the resilience of the temporomandibular joints. True centric relation can only be achieved from the relaxed rest position of the mandible, or what is sometimes called the "relaxed centric relation." From this position the mandible is directed into the correct physiological occlusion only when all occlusal details are in harmony with the laws of articulation; in other words, no interferences can be present.

DIAGNOSTIC TECHNIC

Obviously it is easier to study the position of the teeth and any irregularities such as abraded surfaces or interfering cusps on an exact study model than it is in the mouth itself. Ostman[2] pointed out in 1930 that it was useful to note on such models the depth of pockets and the degree of firmness of the teeth.

Certain authors state that the mandibular joint is not of primary importance in the movements in articulation, and that these movements are guided entirely by the occlusal surfaces of the teeth. It is true that such guidance does take place, but the path dictated by these movements, and the path which the condyle simultaneously describes in the mandibular joint should conform. This should be self-evident to anyone who has studied these problems and has observed them clinically.

It is not possible to determine accurately on a study model what is taking place in the mouth during the act of articulation, unless the model is mounted on an instrument (an articulator) with the teeth in such a relation that any cuspal interference that may occur is not allowed to misdirect the mandible. In other words, the models must not be mounted in a habitual centric occlusal relation but in the relaxed actual centric occlusal relation.

For this reason investigation must be performed with study models mounted (by means of a face-bow) in an adjustable articulator in which the path of the condyle can be copied with the necessary degree of accuracy. Complete accuracy is not possible with such an instrument, nor is it desirable because there are bound to be errors in the original registering procedure.

Space does not permit an extensive description of the technical manipulations and of the difficulties involved in transferring the models to the articulator; nevertheless, it should be stressed that not only is the intraoral method of registration not difficult to master, but also it gives results that are far superior to those achieved by the extraoral method.

A brief outline of the procedure is as follows:

1. Lindblom, G. Balanced occlusion (articulation). D. Cosmos 75:979 Oct.; 1063 Nov.; 1197 Dec. 1933.

2. Ostman, Birger. Das Paradentosen-Modell. Die Zahnärztliche Rundschau 34:153 March 15, 1925.

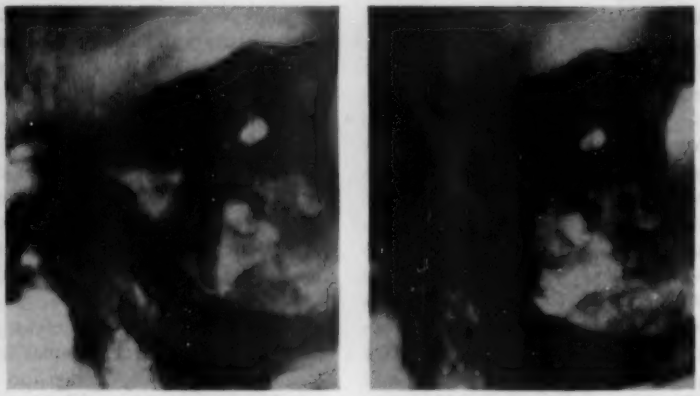

Fig. 1 • Typical shape of condyle and fossa in patient who has "normal bite." Left: Teeth in centric occlusion. Right: Mandible is open 2 cm.

1. The upper study model is mounted in the articulator by face-bow transfer.

2. Soft wax is interposed between the patient's jaws, and an intraoral record is taken of the teeth in the relaxed centric relation. The patient is instructed to close gently into the soft wax and to stop before any occlusal surfaces come into contact.

3. After chilling the wax record, the lower model is mounted in the articulator.

4. Condylar path registration is carried out in the usual way.

5. On removal of the centric wax record and closure of the articulator, the occlusal details will guide the two models into habitual centric occlusion; if cusp impediments exist, the operator will be able to detect them and also to observe any displacement in the condylar mechanism of the articulator. By scraping or grinding on the models those cusps or cuspal planes that act as impediments, the occlusal curves and details can be corrected, thus securing as completely balanced an articulation as possible.

It is possible to detect a major or minor displacement in the condylar mechanism when a cusp impediment directs the lower jaw into habitual (false) centric occlusion. Such a displacement occurs also in the temporomandibular joint and must be diagnosed.

Around 1930 the question as to how to diagnose a displacement of the temporomandibular joint began to attract increasing attention, and this resulted in the development of various roentgenographic technics. Today it is possible to study the opening movement roentgenographically, to observe how long it remains a pure rotatory movement, to establish the point at which the condyle begins to move forward and downward along the oblique plane of the articular eminence, and finally to determine its ultimate position after maximal opening. It is now possible to verify roentgenographically what previously had been mere empirical supposition. With these roentgenographic checks of the temporomandibular joint, the array of diagnostic weapons is complete. What is more important, it is a valuable method for determining in advance whether a genuine deep bite or merely a lowered bite exists.[3]

The roentgenographic check not only provides information about the shape and

3. Lindblom, G. Importance of balanced occlusion. D. Record 59:1 Jan. 1939.

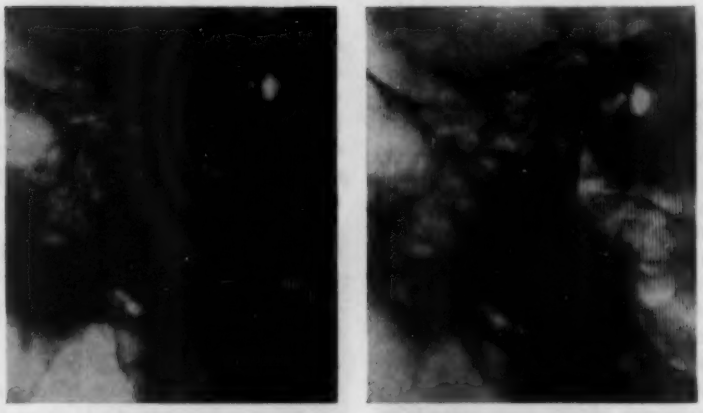

Fig. 2 • Typical shape of condyle and fossa in patient who has "edge to edge" bite. Left: Teeth in centric occlusion. Right: Mandible is open 2 cm. Notice shallow fossa and blunt condyle

type of joint (Fig. 1-3), such as deep and narrow fossa, or shallow and wide ones, but it also indicates the location of the condyle in the fossa—whether it is in the rest position and symmetrical in both joints, whether it is displaced forward or backward, and whether such a displacement is unilateral or bilateral (Fig. 4, 5). Such a roentgenographic diagnosis of the temporomandibular joint, if carried out properly, affords the best and most reliable evidence of a correct relaxed

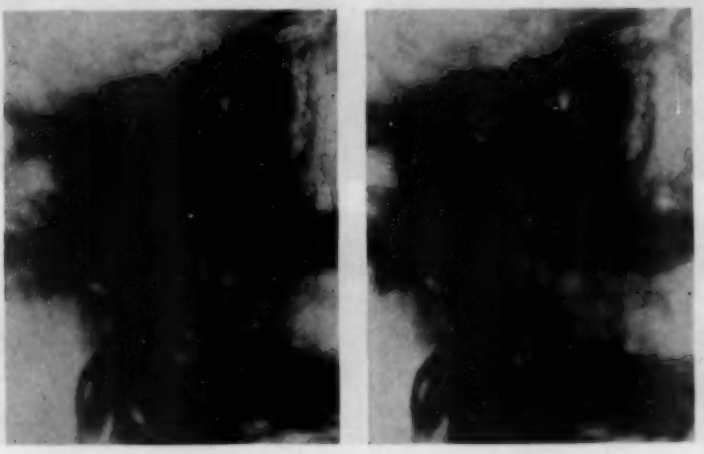

Fig. 3 • Typical shape of condyle and fossa in patient with genuine "deep bite." Left: Teeth in centric occlusion. Right: Mandible open 2 cm. Notice very deep fossa with almost vertical slope and very limited space in sagittal direction (retouched for clarity)

centric record; in other words, of the correct rest position of the mandible.

BITE ANALYSIS

A bite analysis should precede and serve as a basis not only for prosthetic treatment but also for the surgical treatment of periodontal diseases and, indeed, for the orthodontic correction of a bite. Similarly, the purely conservative treatment of a bite often must be based on preliminary examination and planning of this kind. Finally, such an analysis is of primary importance when the large group of disturbances of the temporomandibular joints called temporomandibular arthroses are being diagnosed and their treatment is being planned.

A proper bite analysis requires (1) a comprehensive case history; (2) a complete roentgenographic examination of all teeth; (3) a careful examination of the oral conditions; (4) good and accurate models of the upper and lower jaws; (5) a survey of the occlusion and articulation carried out by means of the two models, mounted as described earlier, in an adjustable articulator, and by the record made of any cuspal interferences that may exist during functional movement of the jaws.

On the basis of this information, it will be possible to devise a diagnostic plan for the treatment of the patient in question—a bite analysis in the widest sense of the term.

Case History • The case history should not be overelaborate. Only those factors that serve as positive guides in the daily work should be noted, together with those already mentioned at the beginning of this article. Close cooperation with a physician also is necessary, for experience has shown that the fundamental cause of periodontal disease must be sought somewhere in the internal metabolic processes.

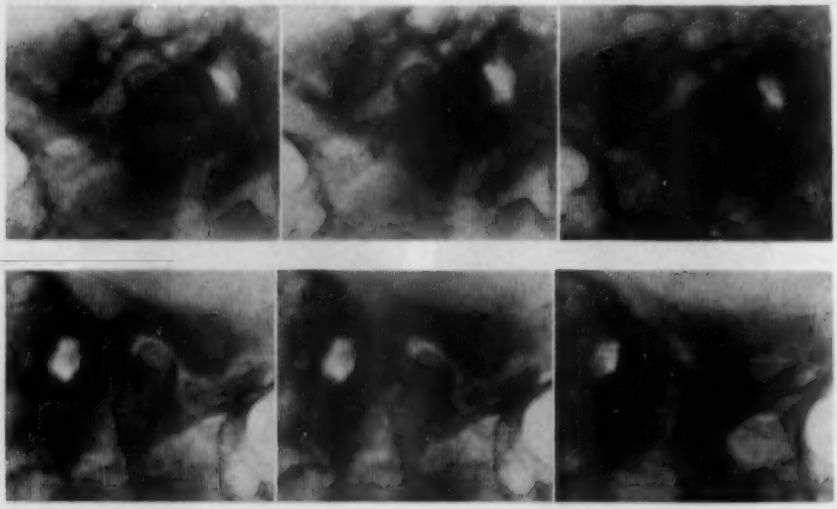

Fig. 4 • Differences when teeth are in "habitual" and in "relaxed" centric occlusion. Above: Right condyle when teeth are in habitual occlusion (biting tightly together); mandible in relaxed position; in maximal open position. Below: Left condyle when teeth and mandible are in same three positions

Examination of the blood and metabolism is sometimes necessary as well as determination of vitamin levels and possible hormonal deficiency.

Roentgenographic Examination • Full-mouth roentgenograms must be taken in order to show clearly not only each individual tooth but the entire alveolar process, the interdental septa and the periodontal spaces. Not only those teeth that subsequently will serve as bridge abutments must be considered, but the condition of the remaining teeth must

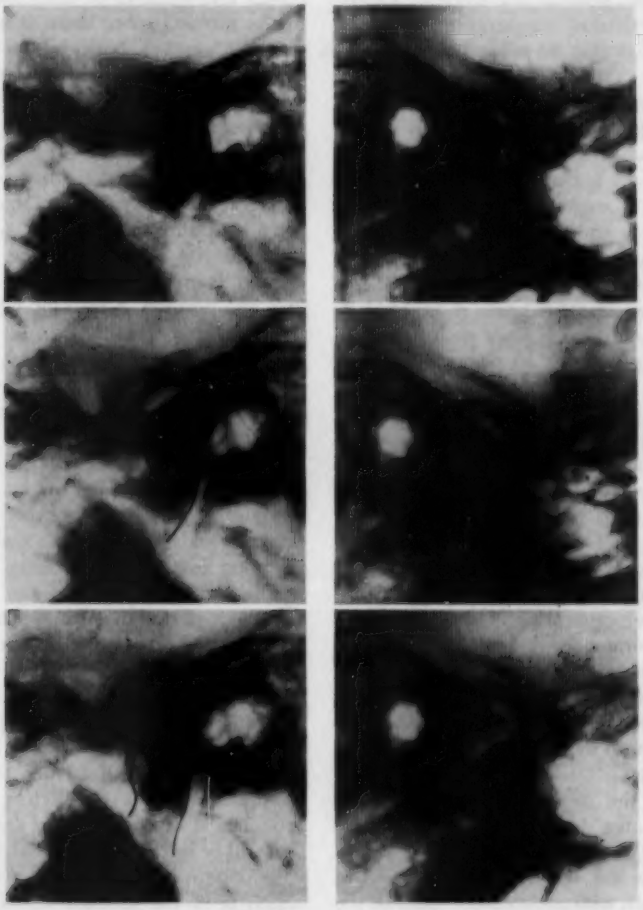

Fig. 5 • Patient with arthrosis. Above: Left and right condyles. Faulty position of left condyle when teeth are in habitual occlusion. Left condyle is forced upward and backward in fossa because of cuspal interference. Center: Condyles are in uniform and correct position now that mandible is in relaxed and corrected position. Below: Condyles are at uniform and correct position at maximal opening of mouth (retouched for clarity)

be noted so as to form a basis for a prognosis for the mouth as a whole and for the plan of treatment.

Examination of the Oral Conditions • All conspicuous external factors should be noted, such as the color and nature of the gingiva, degree of firmness of the teeth, type of bite, general oral hygiene, formation of calculus, suppuration, and any pockets that may be present.

Analysis of the Articulation • An analysis of the articulation is carried out on the articulator in the manner already described, and a careful note made as to which teeth require grinding, where and how much, in order to bring the two arches into as perfect an articulatory equilibrium as possible.[4]

The laws of articulation should not be applied uncritically, since such an application might result in severe mutilation of sound teeth or in overloading of the periodontium. Here, as in other forms of dental treatment, it often is necessary to resort to a compromise, guided by common sense and clinical experience. The value of such preliminary planning for a complicated and extensive bite reconstruction case is obvious. Before the practical work in the mouth is begun—for instance, the preparation of abutment teeth—the operator will know in advance exactly how it has to be carried out and how much and where each tooth must be corrected in height or straightened up, in addition to the grinding for the normal preparation.

Again, the importance of roentgenograms of the temporomandibular joint should be stressed, provided such roentgenograms are taken and interpreted in conjunction with articulatory study of the bite. A separate roentgenogram of the joint will be of little real value unless it is implemented by further information regarding the bite conditions or the articulation.

A series of three pictures of the same joint—one in relaxed centric position (the so-called rest position); one in habitual centric occlusion, and finally, one in maximal opening position—is best. By comparison of these with the series taken of the opposite joint, it is possible to ascertain (1) whether, as a result of cuspal interferences or from loss of teeth in the molar region, there is a displacement in one or both joints when the mandible is closed from rest position into habitual centric position (Fig. 4, 5); (2) whether the condyle moves to a normal extent, either in one or in both joints, in maximal opening of the jaws; (3) whether, as shown by the shape of the fossa and the condyle and what takes place in the joint when the mouth is opened from habitual centric occlusion into rest position, a genuine deep bite or lowered bite is present.[1-3]

Experience during the past 15 years has proved the great importance of roentgenograms of the temporomandibular joint in the development of a successful plan for the treatment of an individual case; that is to say, for the bite analysis. Through such roentgenograms the practitioner avoids uncertainty and lack of planning in the daily routine.

The dentists of today can plan the treatment of a case carefully in advance. In fact, the reconstructed study models not only are a model of the finished product, but also furnish direct guidance for the work of preparation. It is possible to see how much each tooth must be ground or straightened so that when the treated mouth is ready, a satisfactory balanced articulation will be achieved and its function will be as near to the ideal as possible. This is perhaps the task of bite analysis which is of the greatest importance for odontology today.

Sturegatan 32

4. Lindblom, G. Significance of "bite analysis" in modern dentistry. D. Record 68:254 Nov. 1948.

Role of the neuromuscular system in functional activity of the mandible

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Modern dental practitioners cannot ignore fundamental physiological phenomena if they are to do their part in the improvement of the health and well-being of mankind. Because of the relative ease of application of such modern methods as ultramicroscopy, bio-assay and roentgenology, much has been learned about normal and abnormal activity patterns of the teeth, of their supporting structures and of the temporomandibular joint in rest, activity and occlusion.[1-5]

Although the neuromuscular system is in delicate balance and the gradations of contraction are infinite, the system, nevertheless, provides all the power and dominates all the changes in the mechanical functions of the mouth.

NEUROMUSCULAR SYSTEM

Types and Functions of Muscle • The basic unit of the neuromuscular system is the so-called "motor unit," which is made up of numerous muscle cells and one motor nerve composed of a cell body and an axon. A muscle is comprised of many motor units, some of which have long, parallel, individual, multinucleated muscle fibers ensheathed in connective tissue, while others resemble strands attached to the quill of a feather. The temporal muscle is an example of the former type; of the latter type are the masseter and internal pterygoid muscles, which, in addition to their multidirectional pull, may develop greater power[5] because they have a greater number of shorter fibers. Thus, in the body there are muscles which are organized according to the needs of the attached structures for direction, speed and power.

The chemical and microscopic structure of muscle likewise appears suited to the function of the particular muscle. For example, muscles involved in sustained contraction, as the postcervical muscles, are dark in color because of the presence of large amounts of myoglobin, while the ocular muscles are "white meat" because of their relatively weak, delicate and brief contractions. Furthermore, the "motor unit" of the ocular muscle has about six muscle fibers per motor nerve whereas the postcervical muscle has about 150 fibers per motor nerve.

Most anatomy books assign a particular

Presented in the postgraduate course "Analysis and Treatment of the Stomatognathic System," Chicago, Northwestern University Dental School, April 1-3, 1953.

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4. Lord, Frederic P. Movements of the jaw and how they are effected. Internat. J. Orthodont. 23:557 June 1937.

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function to each muscle, but they do not point out that each muscle may have many other functions as well. For instance, all muscles attached to the mandible have some active part in mastication, either in contracting or in relaxing. The contribution of muscle to oral activity is governed by the architecture of the jaw and muscle attachment, by occlusal relations of the teeth, by the demands of various types of food and by the innate or acquired functional pattern of the individual.

The placement of dental restorations which are not perfectly adapted to the existing pattern of parts and their functional movements will cause pounding of the tooth and its restoration through the action of the resisting oral musculature during occlusion. This pounding will continue until the units are thrust aside, the functional pattern is changed, or the parts are lost. In the words of Todd,[6] "Mechanically, physiologically, and psychologically, the human body is compelled to struggle for a state of equilibrium."

Reflexes • Since the control of deliberate or voluntary movements of the oral cavity is not within the scope of this paper, consideration of the nervous control of stomatognathic activity is confined to reflexes. A simple reflex arc consists of sensory fibers of the nerve returning from a reception region to intercalated, internuncial or adjustor cells in the cord, or higher centers, and the efferent or motor nerves to the muscle. The main regions of sensory nerve distribution associated with the reflex control of the mandible are the periodontal membranes surrounding the teeth, the gingivae adjacent to the teeth, the buccal mucosa and the anterior portion of the hard palate.[7] Anyone who has had the misfortune of biting the buccal mucosa in chewing can attest to the speed and efficiency of this reflex. The classic example is that of biting into a bone or a foreign object in food during mastication: sudden and strong reflexes bring about the immediate arrest of closure and the prompt opening of the jaws.

An example of the degree of sensitivity of this receptive mechanism is the ability to detect even a hair between proximal surfaces of teeth or occluding incisors. The complexity of this system is manifested in the ability to recognize infinite variations of consistency in the oral contents.

Rest Position • Rest position is the product of bony architecture; genetically determined number, length, points of origin and insertion; and reflex action of muscle fiber. It is established and maintained by the tonus of the slinglike musculature which supports the mandible. It is dependent on the resting length of the masseter, internal pterygoid and temporal muscles. The position of the mandible through tonus is a postural relation maintained by the random, alternating contraction of the individual motor units of all voluntary muscles under reflex nerve action; that is, tonus is self-propagating. The activity called tonus can be compared to the idling of an automobile engine—it is a state of readiness for instant activity maintained with a minimal expenditure of energy.

Thompson[8] emphasizes the stability of the rest position and its practical importance to dentistry. Sicher[5] stresses its permanence, stating that only severe chronic illness will alter the tonus activity of these muscles.

ELECTROMYOGRAPHIC ANALYSIS

The discovery of the role of nerves, reflexes and muscles in the dynamic com-

6. Todd, Mabel E. The thinking body. New York, Harper & Bros., 1937.

7. Sherrington, Charles S. Selected writings, D. Denny-Brown, editor. New York, Paul B. Hoeber, Inc., 1940, p. 191.

8. Thompson, J. R. A cephalometric study of the movements of the mandible. J.A.D.A. 28:750 May 1941.

plex of rest position, occlusion and mastication was disclosed in the contributions of Moyers[9] and Pruzansky,[10] who applied electromyography to the study of the musculature of the temporomandibular joint.

When a muscle contracts, physical, chemical, thermal and electrical changes occur in the individual fibers. Since there is an electrical change associated with the contraction of a muscle cell and since gradation of muscle contraction is accomplished by the number of muscle cells contracting, registration of the electrical activity of an active muscle provides a record proportionate to force or movement.

On an electromyograph these diminutive electrical discharges are picked up by either surface or needle electrodes. These microcurrents are then amplified many thousands of times. To convert this electrical energy to mechanical energy, the amplified currents are played against Rochelle salt crystals of a crystograph. When crystals of this type are subjected to electrical currents on one surface, torsion results. This torsion is transmitted through a spring to a pen point, which deflects in direct ratio to the current applied; and an inked record called an electromyogram is produced.

Application of these principles and equipment has demonstrated that structural differences, such as malocclusions,[9] pathologic conditions of nervous or muscular origin[10] and the alteration of individual tooth position,[11] produce distinctive results on myograms.

The electromyograms of Figures 1, 2 and 3 show the mastication patterns of a patient with normal occlusion; they were taken in immediate sequence and reveal the following features: (1) the relation of the pairs of masseter and temporal muscles to each other in extent and time of activity, (2) the occurrence of greater activity on the working side in mastication, (3) the qualitative uniformity of activity when a response is repeated and

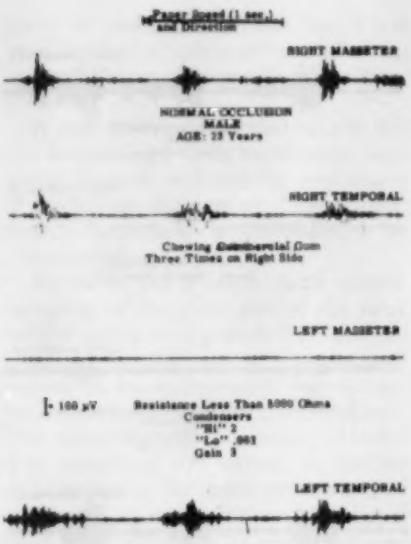


Fig. 1 • Electromyogram of patient, with normal occlusion, chewing gum

(4) the gradation and extent of activity with increasing load.

TRANSFORMED MYOGRAMS

In order to compare several records of an individual patient as well as the records of different patients more precisely, the original myograms were transformed by the following technic. The crystographic pens were aligned so that a perpendicular to the margin of the tracing point, at any point, would pass through the same instant in the record of each of the four muscles being studied.

In the chewing exercise a line was

9. Moyers, R. E. An electromyographic analysis of certain muscles involved in the temporomandibular movements. Am. J. Orthodont. 36:481 July 1950.

10. Pruzansky, Samuel. The application of electromyography to dental research. J.A.D.A. 44:49 Jan. 1952.

11. Perry, H. T. An electromyographic study of the temporal and masseter muscles of Class II Division I malocclusion patients and normal occlusion patients during function. Master's thesis, Northwestern University, 1954.

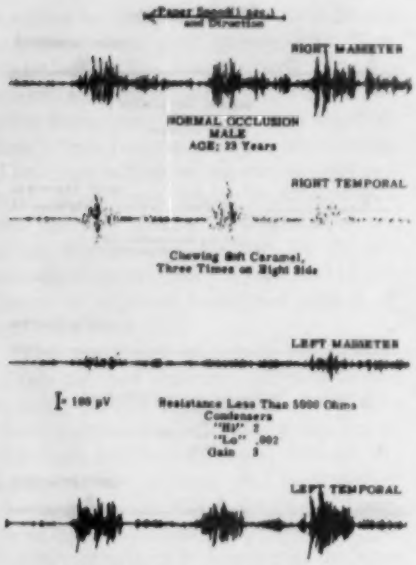


Fig. 2 • Myogram of patient, with normal occlusion, chewing soft caramel

drawn at right angles to the margins of the paper a short distance before the first chewing envelope. This line served as the base line for each muscle unit. The point of intersection of this vertical line with each horizontal muscle unit line was taken as the zero time of that unit. From this point, each 5 mm. of distance on the paper along the record line was marked lightly throughout the entire chewing cycle. These 5 mm. distances at this particular speed of tracing were at intervals of 50 milliseconds. A record of the entire chewing cycle as produced on the electromyogram is shown in Figure 4.

After the 50 millisecond intervals were marked for the entire length of each of the four units, the amplitude of each spike was determined with a pair of dividers. The entire wave from peak to valley was measured in millimeters. In order that suitable graphs could be constructed, the amplitudes for each 50 millisecond interval were totaled as shown in Figure 5, which is an enlargement of the encircled chewing envelope in Figure 4.

This procedure was repeated for each muscle unit along its entire record length. The values at 50 millisecond intervals were then plotted graphically. Each muscle unit in the original study was represented by a different colored line on the graphs.

This method of record analysis made it possible to superimpose all the units studied and to compare timing variations as well as amplitude changes of each muscle with any other. Records as seen in Figure 4 were transformed by this technic. The resultant record charts are shown in Figures 6 through 10.

It must be remembered in studying these figures that the record as it comes off the crystograph runs from right to left; but after it is transformed, it reads conventionally, from left to right. Therefore, all original tracings from the electromyograph read from right to left while all charts read from left to right.

Such conversion is valuable since it reveals additional qualities, including presence or absence of synchronism of activity in muscle groups and magnitudes and durations of activity.

INTERPRETATION OF MYOGRAMS

This instrument and technic were used to obtain myograms of the action of the masseter and temporal muscles of ten patients with cephalometrically and anatomically normal occlusion. The myograms, of which Figures 6 and 7 are typical, revealed the following characteristics of muscular action during the chewing of gum:

1. As they reached maximal activity, the temporal and masseter muscles on both sides were synchronized.
2. The temporal muscles always displayed electrical activity before the masseter muscles went into action.
3. There was more harmony and

smoothness of action-potential discharge on the side preferred for mastication.

4. The amplitude of the myogram was in direct proportion to the resistance of the bolus being chewed.

Myograms may prove of clinical value. The following typical characteristics were observed in Class II Division 1 malocclusions (Fig. 8 and 9).

1. The temporal and masseter muscles on both sides reached maximal activity asynchronously.
2. The masseter muscles frequently were first to manifest electrical activity.
3. There was much less harmony and virtually no smoothness of action-potential discharge on both sides, although there was less disharmony on the preferred side.
4. Although gradation of activity has not yet been thoroughly studied in this group of patients, it appears that it will be difficult to demonstrate gradation because of the complex pattern of the myogram.

It may be concluded that muscle has the dominating role in mastication, supplying function and resisting any degree of mechanical disharmony. The evidence, already abundant, is corroborated by electromyograms.

Figure 10, for example, is an electromyogram of the right side of the same subject shown in Figure 6. The occlusal condition of this patient was declared normal by six orthodontists who did not use electromyography in their diagnosis. The electromyograph, however, revealed that something was wrong; by further examination of the study models and of the mouth, it was found that the upper right third molar was in premature contact.

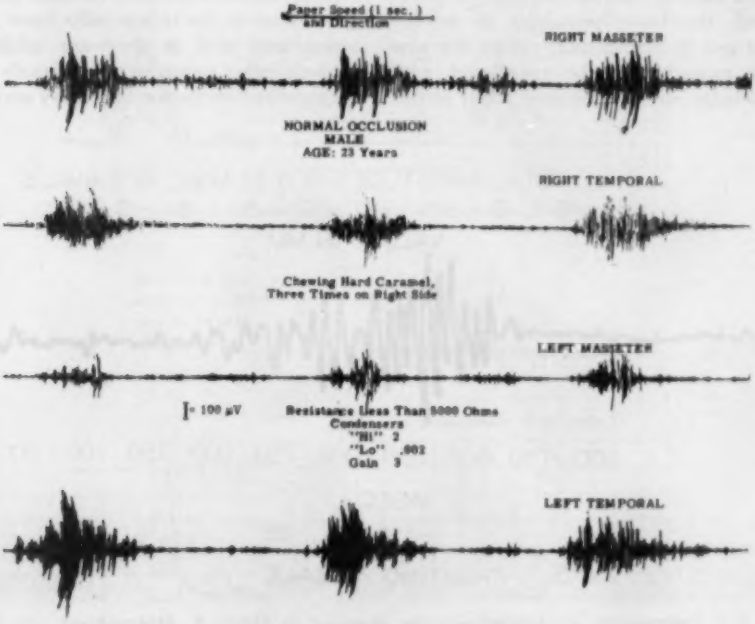


Fig. 3 • Myogram of patient, with normal occlusion, chewing hard caramel

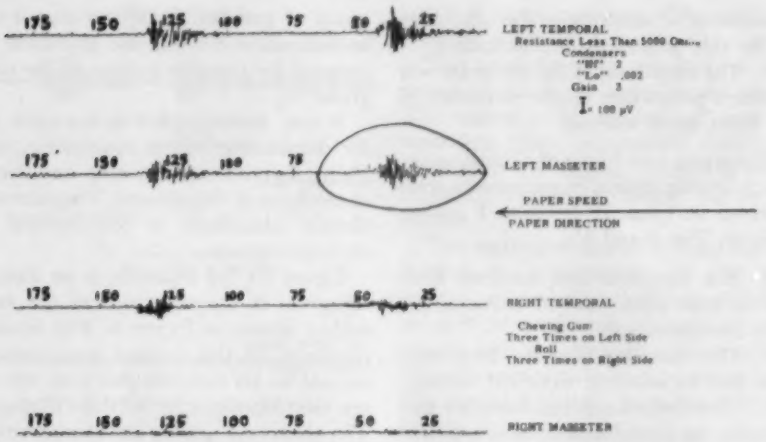
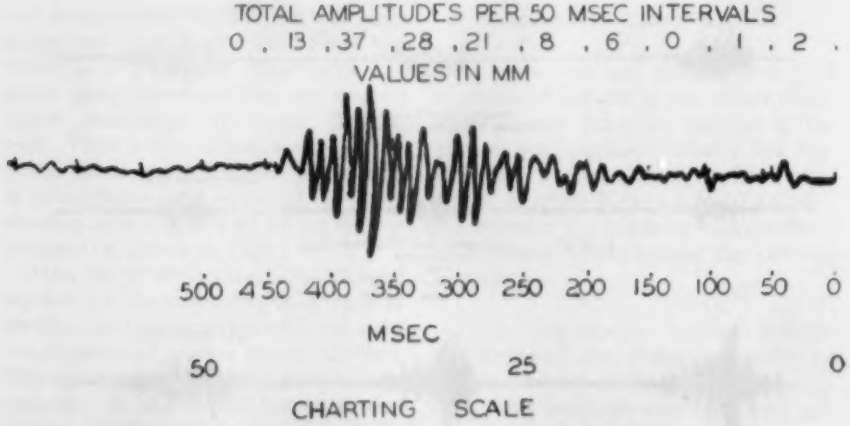


Fig. 4 • Myogram of patient, with normal occlusion, chewing gum

DISCUSSION

When a new method of scientific investigation such as electromyography is introduced, the basic principles of science must not be abandoned; rather the new facts gained must be correlated with knowledge already acquired. Only in this manner can scientific progress be made.

In malocclusions such as those described in this article physically disturbed interdigitation is present; occlusal movements start as the motor units come into action and stop as they are inhibited through reflex action by the untimely and disorganized excitation of sensory endings


TOTAL AMPLITUDES PER 50 MSEC INTERVALS
0 . 13 . 37 . 28 . 21 . 8 . 6 . 0 . 1 . 2 .
VALUES IN MM
500 450 400 350 300 250 200 150 100 50 0
MSEC
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CHARTING SCALE

Fig. 5 • Enlargement of chewing envelope encircled in Figure 4. Measurements are those used in transforming myograms to graphs

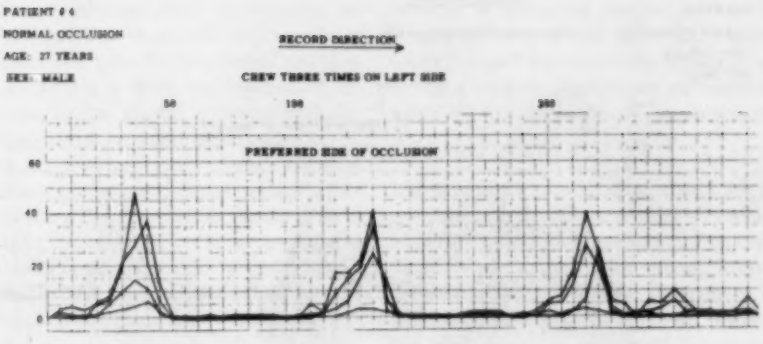

Fig. 6 • Record of patient, with normal occlusion, chewing gum

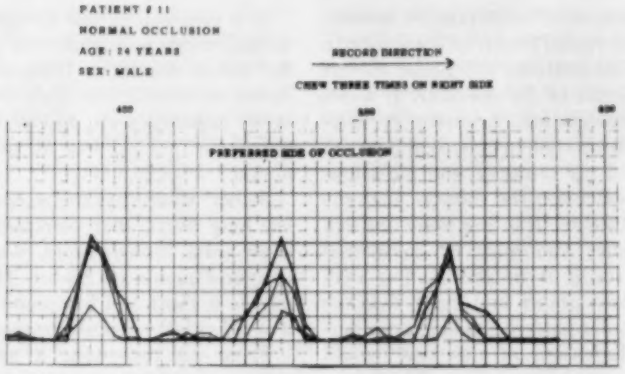

Fig. 7 • Record of patient, with normal occlusion, chewing gum

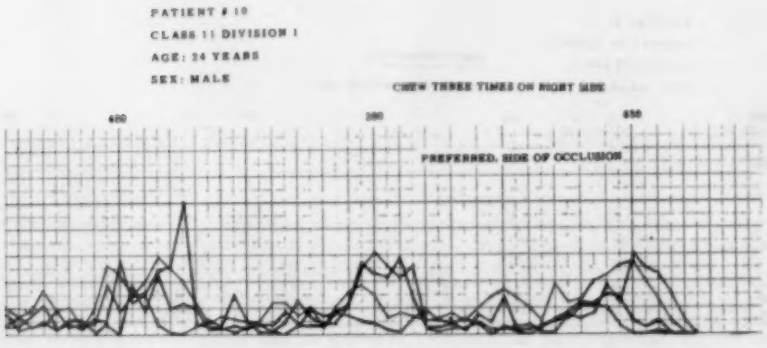

Fig. 8 • Record of patient, with Class I Division 1 malocclusion, chewing gum

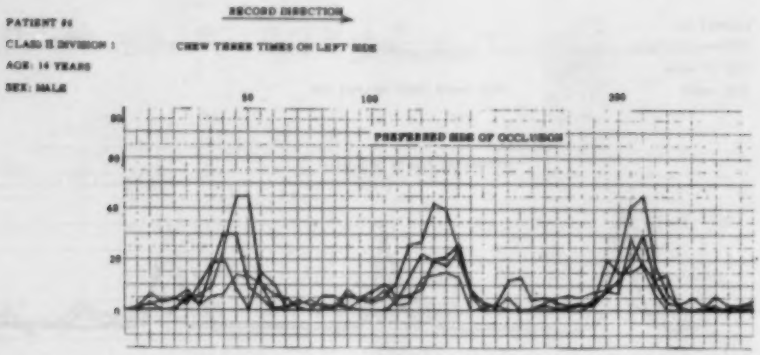

Fig. 9 • Record of patient, with Class II Division 1 malocclusion, chewing gum

in the periodontal membrane. A restoration with beautiful luster, an ideal margin and clear-cut anatomy will please the eye and conscience of the operator. It meets his requirements for "extension for prevention," but too often extension does not pass beyond the limits of that particular tooth. In extension the natural anatomy of the unfilled teeth in the same and opposing arches also must be considered carefully, for it is in conjunction with these inclined planes and cusps that the neuromuscular pattern has long been performing. Extension of this type would mean the prevention of possible future periodontal disturbances.

It is common dental knowledge that a missing tooth will distort the anatomy of the entire dentition. Unfavorable force causes drifting in one arch, overeruption in the opposing arch, and attrition of opposing surfaces. Force is produced by muscle.

Sicher[5] states that the temporal muscle has long fibers, that therefore it is relatively weak though rapid in action. The temporal muscle is a mover. The masseter muscle is short and bipennate; therefore, it is a worker—a power muscle.

From the myograms it appears that temporal activity precedes masseter activity in chewing; therefore, in the light

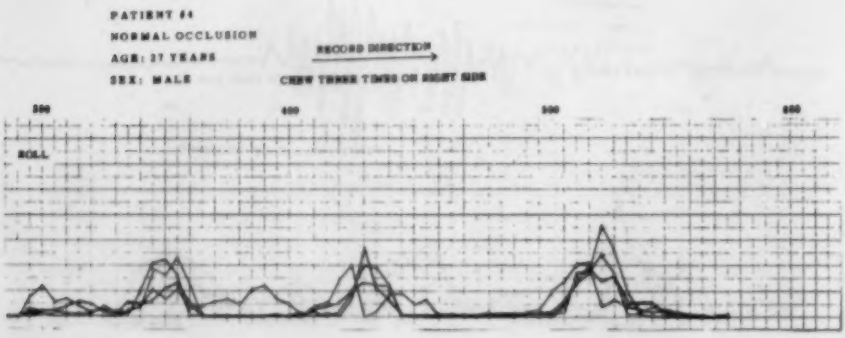

Fig. 10 • Record of patient chewing gum; occlusion normal except for supraerupted third molar

of present information it is tempting to believe that the temporal muscle moves the mandible into the functional position and its action is then complemented by the contraction of the masseter muscle. Analyses must be made with caution.

On an electromyogram the recording of action potentials from a muscle does not necessarily mean that the muscle is initiating or causing the movements of a part. The muscle could be holding or balancing the part while other muscle units act as the movers.

For example, in the process of chewing, the digastric muscle produces action potentials while the mandible moves from rest to occlusion. Yet it cannot be concluded that the digastric muscle is an elevator of the mandible. Physiologically, anatomically and teleologically, such a function would be impossible—a muscle is totally incapable of pushing. Apparently it does act in the elevation of the mandible but only as a holding force to prevent a snapping action in closure. Dogmatic conclusions of what happens when the oral structures are working cannot be drawn from evidence accumulated when these structures are motionless.

CONCLUSION

Many neuromuscular phenomena are not yet understood; future research in neuromuscular physiology will unquestionably be of great assistance in the solution of clinical problems. In the meantime, the dentist must recognize that all force in the oral cavity is produced by muscle. The number, origin and insertion of fibers and their innervation are established genetically. These are the structures most resistant to change in the entire body. Therefore, the best means of helping the patient is to restore or maintain the normal physiology of the mouth, seeking to cooperate with these structures rather than causing them to resist and to produce pathologic conditions.

Nutrition as Analogy • The vital fact about healthy human powers is that they develop by use in an environment which invites and facilitates such use; whilst they atrophy when disuse is their fate, either by reason of an inherent fault or an inhibiting environment. To be precise, it is not the poverty of the environment so much as the poverty or impossibility of response thereto, which results in atrophy and poor development. These principles are well illustrated in human nutrition. A thriving digestion and good food contribute to a robust appetite. It is a spiral of ascent and its end may be health. A poor digestion, on the other hand, and poor food endanger nutrition. It is a spiral of descent and the end will be disease. *K. E. Barlow. The Medical Press 224:402, 1953.*

Occlusal changes in adult dentition

Henry L. Beyron, L.D.S., M.S.D., Stockholm, Sweden

While the development of the deciduous and mixed dentitions has been the subject of several serial investigations, the literature contains no report of such a study of progressive changes in adult dentition. Parma,[1] Ackermann,[2] Wild,[3] Moses[4] and others have studied the changes in adult dentition by means of single examinations of dentitions with various degrees of attrition. Such studies, however, reveal only the final result and not the course of the changes or the factors influencing them.

Serial investigations made during treatment likewise are concerned only with the result. Occlusal changes and the factors that influence them are difficult to ascertain, since extraction or restoration itself involves an alteration of the occlusion and influences the subsequent occlusal changes. The manifest difficulty in a serial investigation of adult dentition lies in the fact that it must be carried out on dentitions with complete arches in which no, or very little, conservative or prosthetic work has been performed or is undertaken during the control period. Moreover, the changes occur slowly.

The changes that take place in adult dentition consist of migration of teeth and attrition, both occlusally and interstitially. A single examination provides but a cross section, a momentary picture of a lengthy process. Knowledge of the changes that various types of adult occlusion undergo is of importance then for the evaluation of "momentary" occlusion, for treatment planning and for prognosis of occlusal correction and rehabilitation.

This article is a report on a serial investigation of occlusal changes in adult dentitions. The term "occlusal changes" as used here means the formation of facets of attrition on the occlusal surfaces and changes in position and inclination of the teeth. The investigation was concerned primarily with the questions: What is the appearance and localization of the occlusal changes? What are the factors that influence the appearance and localization of these changes? Since attrition occurs frequently on the tooth surfaces that are in contact in eccentric positions of the mandible, a study was made in each individual case of the mandibular movements and especially of contact gliding.

The changes in the occlusal surface and the position of the teeth were considered of particular interest in connection with the stresses on the supporting tissues.

MATERIAL

From the original group of 138 patients with complete or almost complete dentition some were excluded for the following reasons: (1) The dentitions required extractions or fairly extensive restorative treatment. (2) The patients gave evidence of bruxism or a similar condition. Since the occurrence of bruxism is diffi-

Presented in the postgraduate course "Analysis and Treatment of the Stomatognathic System," Chicago, Northwestern University Dental School, April 1-3, 1953.

1. Parma, C. Die lokalen Ursachen der chronischen Gebisslockerung. Ztschr. f. Stomatol. 41:113 Feb. 26, 1943.

2. Ackermann, F. Le développement occluso-articulaire humain - son principe fondamental hélicoïde. Schweiz. Monatschr. f. Zahnheilk. 56:1082, 1946.

3. Wild, W. Unterkieferbewegungen und Kaubewegungen. Schweiz. Monatschr. f. Zahnheilk. 56:897, 1946.

4. Moses, C. H. Studies of wear. D. Items Interest 68:953 Oct. 1946.

cult to judge and the patient is often unconscious of the condition, the diagnoses made by the author were checked by another dentist. (3) The dentitions were such that the intercuspation in occlusal contact did not accord with centric relaxed mandibulocranial relation.

The final study group consisted of 44 clinically healthy adults, varying in age from 23 to 36 years. In this age range, characteristic attrition usually begins—if it has not already begun—; but it has not yet reached an extreme stage. No clinical symptoms of periodontal disease were present at the initial examination. The dentitions were complete or almost complete. Only minor restorative treatment had been carried out before the initial examination or was performed during the observation period. There were various types of occlusion, including local malpositions. The occlusal contact in all dentitions was such that intercuspation accorded with centric relaxed mandibulocranial relation. In eccentric relations, the occlusal contact varied considerably.

METHOD

The examination consisted of three parts: (1) oral examination of occlusion, (2) analysis of occlusion in an adjustable articulator[5] and (3) study of mandibular movements.

In the comparison of the oral and articulator examinations the number of teeth making contact in centric, protrusive and right and left lateral positions was determined. Examination was made also of the inclination to the horizontal of the paths described in sagittal and lateral contact gliding. The inclination was obtained by measuring on the articulator the angle between the path described by the tip of the incisal pin and the horizontal plane. The following designations were made: flat: 0-20 degrees; moderately steep: 20-35 degrees; steep: 35 degrees and above.

Each dentition was studied during incision and mastication of Swedish hard bread and chewing gum. Observations were made also of movements without food. Special emphasis was placed on the gliding movements with the teeth in contact. It was ascertained whether pronounced (long) or restricted (short) gliding movements occurred and whether pronounced movements in one direction were predominant while movements in other directions were restricted. On the basis of these observations, the pattern of the gliding movements was recorded for each patient. This pattern was termed the movement pattern. These patterns were observed by the author and checked by another dentist.

This examination procedure was repeated for each patient at intervals of 2 to 3 years for periods of 8 to 12 years. Thus, the evaluation of the dentition of each subject was based on a series of clinical observations and a series of casts mounted on the articulator.

RESULTS

It was observed that occlusal changes varied even in the same type of occlusion according to Angle's classification; however, similar occlusal changes occurred in similar movement patterns. The dentitions, therefore, were divided into groups according to the predominant movement patterns as follows:

Group movement pattern	*Men*	*Women*	*Total*
1 Multidirectional gliding movements	8	4	12
2 Predominating bilateral movements	4	3	7
3 Predominating sagittal movements	2	3	5
4A Predominating unilateral movements	7	4	11
4B Predominating unilateral movements with anterior component	5	4	9
	26	18	44

5. Beyron, H. L. Orienteringsproblem vid protetiska rekonstruktioner och bettstudier. Svensk. Tandl.-Tidskr. 35:1 Feb. 1942.

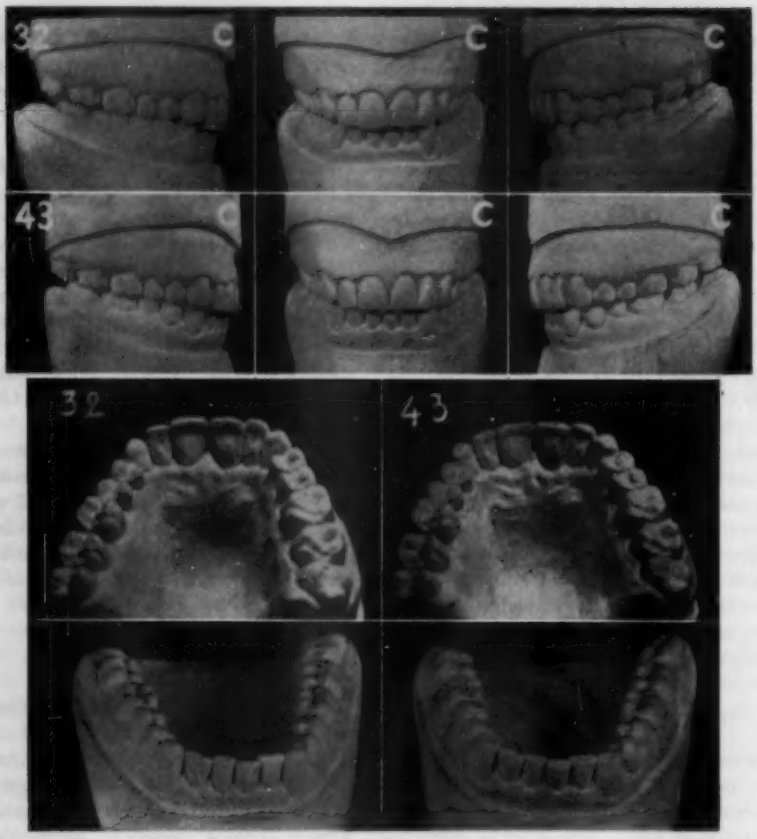

Fig. 1 • Group 1 dentition with multidirectional gliding movements (c, centric position). Occlusal changes, occurring over 11 year period (32-43 years) included contact of more teeth both in lateral and protrusive positions and attrition, resulting in reduction of incisal guidance and of cuspal inclination mesiodistally and buccolingually

Group 1. Multidirectional Gliding Movements • In the dentitions of Group 1 (Fig. 1) the dental arches were regular in form. At the first examination the inclinations of the lateral and sagittal gliding paths were moderately steep and differed little, though the inclination of the sagittal path in all cases was the steeper.

In right and left lateral positions there was contact between most of the teeth on the working side. In the protrusive position there was contact between all incisors.

At the end of the observation period various occlusal changes had taken place. All teeth showed attrition. The contact surfaces had increased, and contact was extended to include more teeth in both lateral and protrusive positions. The inclination of the gliding paths had decreased uniformly.

Group 2. Predominating Bilateral Movements • In the dentitions of Group 2 the dental arches were regular in form. A striking morphologic feature was the pronounced vertical overbite. The inclination of the lateral gliding paths was flat or moderately steep. The inclination of the sagittal gliding path was steep. In lateral positions there was contact between several teeth on the working side; in the protrusive position there was contact between one or two pairs of teeth, usually the central incisors.

The occlusal changes in some cases took the form of a slight tipping of the cuspids and the lateral incisors labially in the maxilla and lingually in the mandible. In all cases attrition had occurred on the posterior teeth. In several instances there were steep mesiodistal attrition facets on the bicuspids (Fig. 2), so that the occlusal surface had the form of a sharp ridge running buccolingually. In some cases these ridges had a transverse direction, while in others they had a more anterior direction.

Group 3. Predominating Sagittal Movements • In the dentitions of Group 3 (Fig. 3), morphologically the arches were regular. The inclination of the lateral gliding paths was steep and that of the forward gliding path moderately steep and flatter than that of the lateral paths. In the protrusive position simultaneous contact could be made between all anterior teeth and some posterior teeth. In three cases, in the right and left lateral positions there was contact only between a few teeth on the working side and in two cases contact only between one or two pairs of teeth on the balancing side.

The occlusal changes consisted of attrition of the anterior teeth and labial tipping of the maxillary teeth. Diastemata developed between the maxillary anterior teeth. Some bicuspids were worn so that the cusps of the mandibular teeth, seen transversely, fitted snugly into the maxillary teeth (Fig. 3, A and B).

Fig. 2 • Shaping of attrition facets mesiodistally on bicuspids in dentitions with bilateral movements (Group 2). Occlusal surface has taken the form of sharp buccolingual ridge

After the dentitions in this group had been observed over the usual period without intervention, the cusps of the bicuspids and molars were corrected so that lateral gliding was possible along flatter paths and with even contact on all teeth of the working side. As a result of the correction, the mandibular movements changed, and the patient was able to perform lateral gliding movements. Thereafter the occlusal development assumed a different, and more favorable, course. The attrition that occurred was general. Furthermore, without any other treatment, the anterior teeth assumed almost their original positions, and the diastemata closed (Fig. 3, B and C).

The changes following correction illustrate further the correlations between the existing occlusal form and the movement pattern and between the movement pattern and the occlusal development.

Group 4 A. Predominating Unilateral Movements • In the dentitions of Group 4 A (Fig. 4), morphologically the dental arches were irregular. In several cases there was buccal or lingual malposition of one or more teeth. Some patients had a cross-bite. A significant feature, moreover, was the major difference in the inclination between the right and left lateral gliding paths and in the number of teeth in contact. One of the lateral gliding

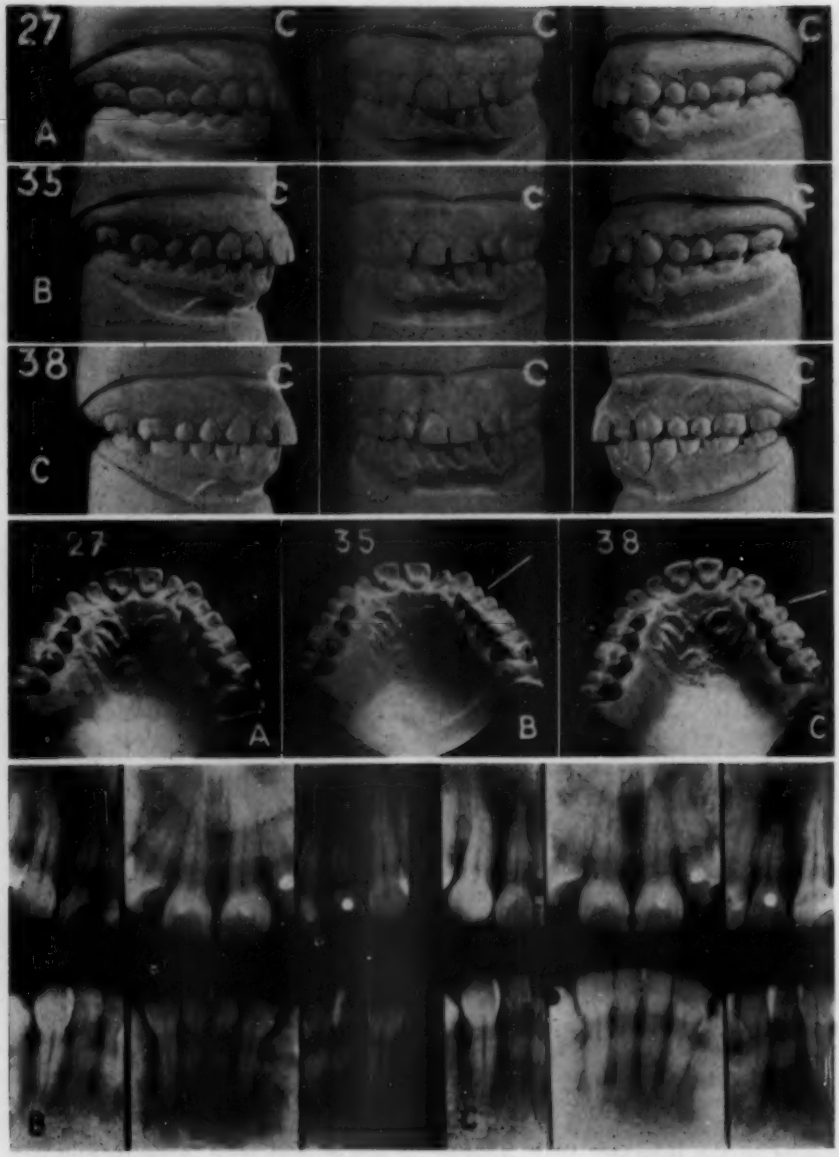

Fig. 3 • Group 3 dentition with sagittal movements predominating (c, centric position). Occlusal changes from A to B, occurring in 8 year control period (27-35 years), included attrition and labial tipping of maxillary anterior teeth and wearing of some bicuspids so that cusps of mandibular teeth fitted snugly into maxillary teeth. Occlusal changes from B to C occurred in three year control period (35-38 years) after cusps of bicuspids and molars were corrected so that lateral movements also could be performed. Note that at end of control period cusps had attrition facets typical of lateral movements, anterior teeth had returned to original positions and diastemata had closed

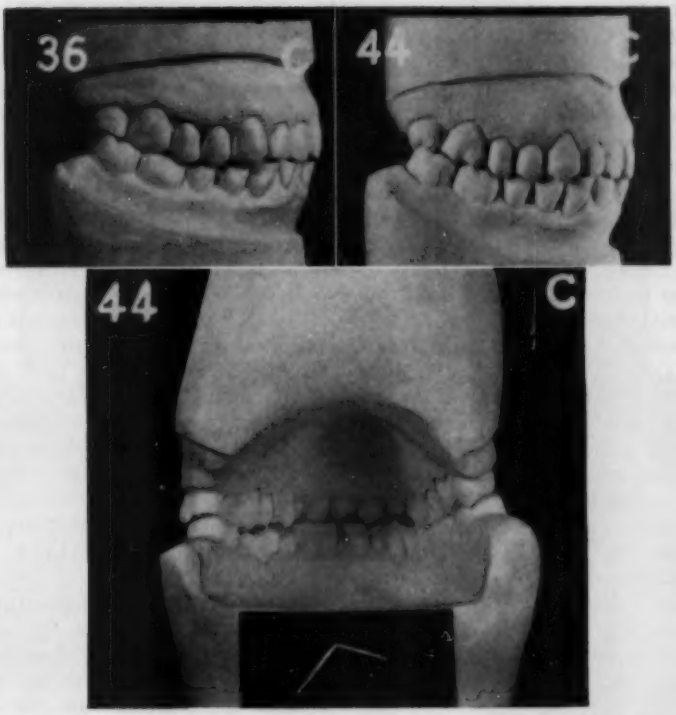

Fig. 4 • Group 4 A dentition with unilateral (right) movements predominating. Occlusal changes, occurring in 8 year control period (36-44 years), included formation of steep mesiodistal facets on bicuspids (above) and attrition in several molars and bicuspids (below). Occlusal surfaces, viewed transversely, were almost oblique planes

paths was consistently steep with few teeth in contact—in some cases one or two teeth on the balancing side—while the other path was moderately steep or flat and had several teeth in contact. The sagittal gliding path was steep or moderately steep.

The occlusal changes during the observation period consisted of slight attrition of the anterior teeth and slight labial tipping of the maxillary anterior teeth on the side toward which the lateral movements were performed. Several molars on both sides and some bicuspids showed attrition. At the final examination the occlusal surface of each of these teeth was almost an oblique plane (Fig. 4, below). The bicuspids on the side toward which lateral movements were performed in several cases had pronounced mesiodistal facets so that characteristic buccolingual ridges developed. Some loss of proximal contact between the bicuspids (Fig. 4, above) occurred in some cases.

Group 4 B. Predominating Unilateral Movements with Anterior Component • Morphologically, the dentitions of Group 4 B resembled those of Group 4 A. The inclination of one lateral gliding path was steep while that of the other was flat or moderately steep. The movement with

the flatter path—one in which contact occurred between the greatest number of teeth—was, however, a lateral gliding movement with a larger anterior component than is found in dentitions in group 4A. The sagittal gliding path was moderately steep.

The occlusal changes which occurred were pronounced attrition and slight labial tipping of the maxillary anterior teeth on the side toward which the movement was performed. On the other side the anterior teeth, which showed no attrition, seemed longer; and the whole anterior region had a characteristic "step" appearance. (See Figure 7 for a case with a similar development.) The occlusal surfaces of several molars on both sides and of some bicuspids were modified by attrition so that they were oblique planes. The bicuspids on the side toward which movements were performed showed attrition in a more diagonal direction. Steep facets were formed, and the cusps of the mandibular bicuspids fitted snugly into the maxillary teeth.

GENERAL OBSERVATIONS

Occlusal changes seem to develop in accordance with the individual pattern of gliding movements with the teeth in contact. The contact gliding movements appear to occur without food between the teeth. In incision and mastication of food, movements from eccentric positions to centric position occur to a very limited extent. This observation is in accord with that of Hildebrand.[6] Jankelson and others[7] maintain that there is no contact other than in centric position, and then only during the final swallow. Observations made in the present investigation showed a certain agreement between the patterns of movements in mastication and movements without food. If the movements without food are predominantly unilateral, it seems that mastication will proceed habitually with a movement on the same side from an open lateral position toward centric position. The movements without food seem to fix the movement pattern. It appears from the observations of all groups in this investigation that the movement pattern is governed to a great extent by the position and occlusion of the teeth.

It has already been pointed out in the literature that a deep overbite, that is, a steep incisal guidance, has a considerable influence on the mandibular movements.[8] The results of the present investigation will give a more general insight into the effect of occlusion on the movements. Gliding movements that must follow a steep path and for which few teeth are in contact are avoided or restricted, whereas movements that follow a flatter path with several teeth in contact are predominant. It should be noted that the movement patterns do not correspond to accepted types of occlusion, for example, Angle's classification.

Malposition of but one or a small number of teeth may result, for a certain movement, in a steep gliding path and contact between few teeth and thus determine the movement pattern and the development. A balancing contact on the molars often results in a steep gliding path and thus obstructs lateral movement. This investigation has not revealed the existence of a universal maximum inclination, beyond which free gliding movements would be obstructed. It seems probable that the maximum inclination varies from one person to another. Observations of patients of different ages suggest that younger persons perform gliding movements with relatively steep paths.

The relation of occlusal changes to the supporting tissues of the teeth is highly significant. The oft-repeated statement

6. Hildebrand, G. Y. Studies in the masticatory movements of the human lower jaw. Skandinav. Arch. f. Physiol. 61, suppl., 1931.

7. Jankelson, Bernard; Hoffman, G. M., and Hendron, J. A. The physiology of the stomatognathic system. J.A.D.A. 46:375 April 1953.

8. Schuyler, C. H. Factors of occlusion applicable to restorative dentistry. J. Pros. Den. 3:772 Nov. 1953.

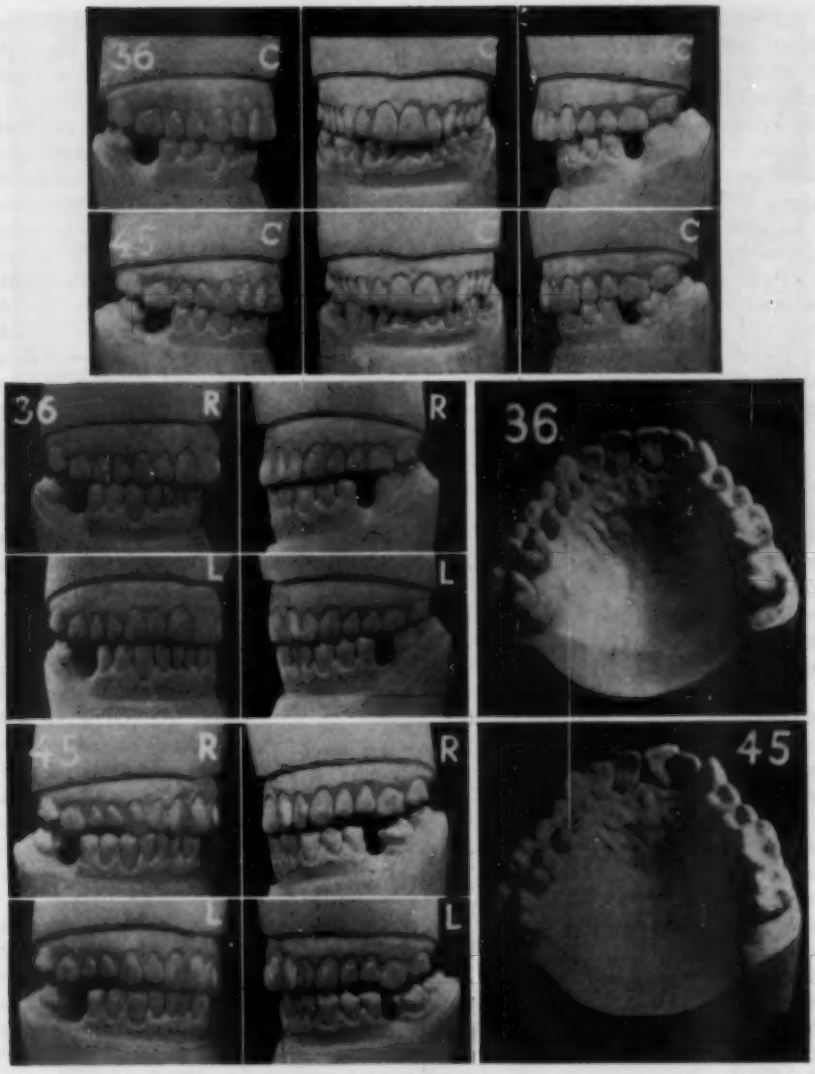

Fig. 5 • Dentition with teeth extracted. Occlusal changes occurring in 9 year control period (36-45 years) included increase in steepness of gliding paths and decrease in number of teeth in contact in eccentric positions. Note lingual tipping of bicuspids, narrowing of arch in this region and buckling in anterior region

that attrition is beneficial is not universally true. The effect of attrition, as of other changes, varies from favorable to unfavorable and depends on the form of the attrition, which varies from one group to another.

Attrition in dentitions with multidirectional gliding (Group 1) results in a decrease of the anterior overbite and a reduction in the cusp inclination both mesiodistally and buccolingually. As a result the teeth are subjected to stress in a more axial, that is to say, a more favorable, direction. The occlusal changes lead, moreover, to an increased distribution of stress. The character of the movements is of the greatest importance. On account of reduction of the cusp inclination and overbite, the teeth are utilized in smooth and even gliding movements. Such movements seem to promote physiologic stimulation of the supporting tissues, as has been emphasized by Bauer and Lang,[9] Häupl,[10] and Box.[11] This reaction is best illustrated by comparing the opposite situation with snugly interlocking bicuspids and steep facets. When movements are performed—attempts at gliding movements—the teeth are subjected to a horizontal, rocking, jarring action, which results in an unfavorable strain on the supporting tissues.

The occlusal changes which occurred in the dentitions of this particular group must therefore be regarded as representing a favorable development from the point of view of stresses.

In dentitions with predominating bilateral movements (Group 2), a reduction in the cusp inclination in the buccolingual direction occurs. This result is favorable in view of the pronounced bilateral movements. The formation of steep mesiodistal facets on bicuspids is a less favorable development. As long as the teeth make mesiodistal contact, the effect is not appreciable. The dentitions of this group in the investigation showed a somewhat unfavorable development.

When sagittal movements predominate (Group 3), the changes in the anterior segment consist partly in attrition and partly in labial tipping. Because of the tipping, the direction of the stress is less favorable. Attrition of some bicuspids makes them occlude snugly, and consequently they may be exposed to a rocking, jarring action. In this group of the study the occlusal changes resulted in a somewhat unfavorable form of occlusion.

When unilateral movements predominate (Group 4), the changes consist of a characteristic development of transverse oblique planes on the molars and often also on the bicuspids. The stress on these teeth therefore deviates more from the axial direction; this is an unfavorable development. In dentitions of the class of Group 4 A, on the bicuspids of the side toward which gliding is performed steep mesiodistal facets often develop causing buccolingual ridges, with the result that the teeth may be exposed to a rocking, jarring action during small restricted movements toward the opposite side. This rocking effect is unfavorable and sometimes leads to loss of interstitial contact, which in turn leads to direct damage to the supporting tissues through food impaction.

When unilateral movements with an anterior component predominate (Group 4 B), the attrition of the bicuspids on the side toward which movement is performed takes place in a diagonal direction. The central fossa of the upper bicuspids is worn diagonally. The buccal and lingual cusps of the bicuspids then interlock snugly in a more transverse direction, and these teeth may be exposed to a rocking, jarring action.

A typical feature of such dentitions is that the changes affect the anterior teeth mainly on the side toward which movements are made. The attrition must be regarded as favorable, and the labial tipping as unfavorable. On the other side, the anterior teeth, which are not worn, seem elongated. It is possible that an actual elongation of these teeth occurs

9. Bauer, W., and Lang, F. J. Ueber das Wandern der Zähne. Vrtljschr. f. Zahnheilk. 44:321, 1928.

10. Häupl, Karl. Grundriss der Histo-Pathologie des Zahnes und seines Stützapparates. Leipzig, Johann Ambrosius Barth, 1940.

11. Box, H. K. Twelve periodontal studies. Toronto, University of Toronto Press, 1940.

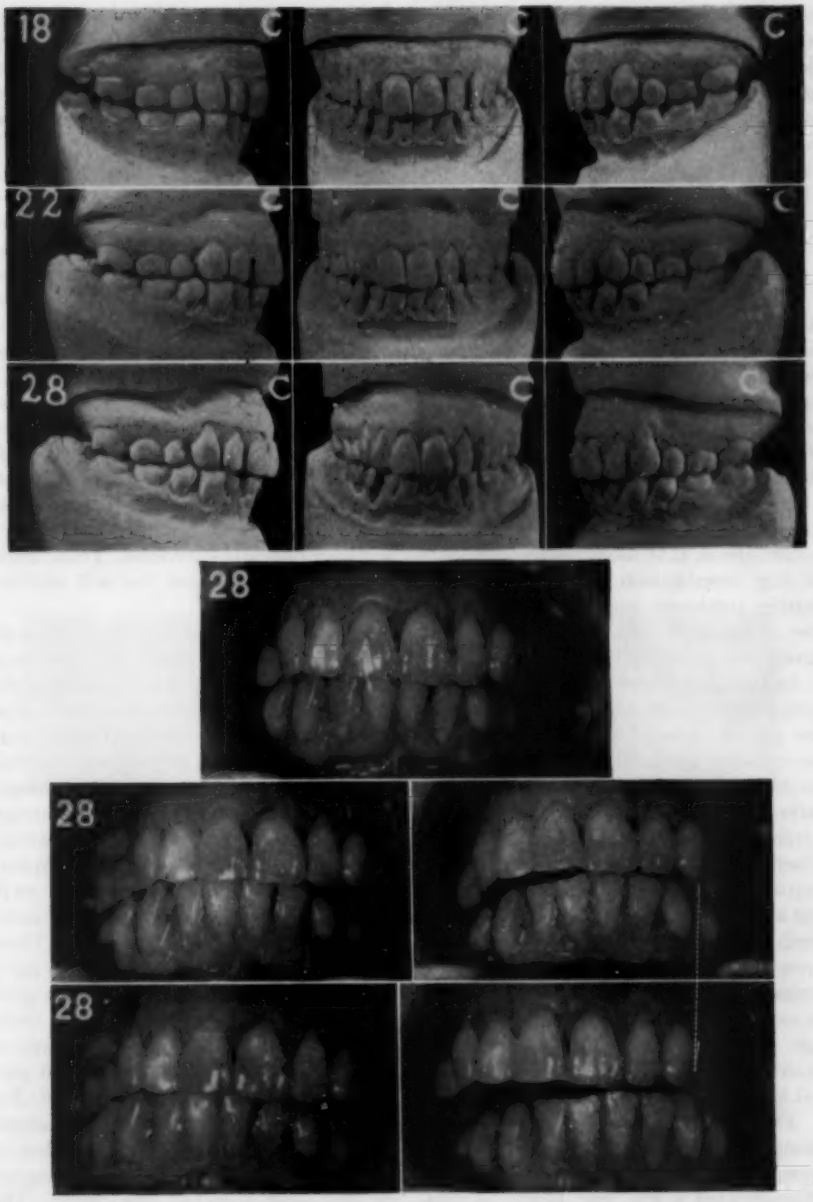

Fig. 6 • Dentition showing result of extraction. Influence on movement pattern and on occlusal changes exerted by elongated lower right third molar over 10 year control period (18-28 years). By the end of the control period unilateral movements to right predominated. Note attrition of teeth on right side, especially on anterior teeth.

secondarily,[12] but whether this is the case is difficult to verify. A secondary elongation may be due to the fact that the teeth never receive axial but only horizontal loading, especially after extrusion. The occlusion resulting from these occlusal changes must be considered as unfavorable.

DENTITIONS WITH EXTRACTIONS AND RESTORATIONS

As has been pointed out in the introduction, it is only in patients with complete dentitions that it is possible to observe a uniform development. In order to obtain wider knowledge of occlusal changes and the factors that influence them, 28 dentitions with extractions and restorations (Fig. 5-7) were studied in a supplementary investigation in which the same procedure as that used in the main part of the investigation was followed. No further treatment was performed during the observation period. Three of these dentitions are described briefly.

In one case where a lower molar had been extracted on each side (Fig. 5), at the age of 36 small bilateral movements were being performed. Attrition facets on the cuspids indicated that longer bilateral movements had been carried out earlier in life. During the course of the observation period the upper first molars extruded, the bicuspids tipped lingually, the arch narrowed in this region, and the teeth in the anterior region became crowded. The gliding paths became progressively steeper, and fewer teeth were in contact in eccentric positions. By the age of 45 the movements had become entirely restricted, and there was a typical locked bite.

The influence of extraction and an elongated lower right third molar on the movement pattern and on occlusal changes over a ten year period is illustrated in Figure 6. After extraction of the upper right third molar at the age of 18 the lower third molar extruded, causing a steep gliding path for lateral movements to the left. At the age of 28 the original bilateral movement pattern had changed so that unilateral movements to the right predominated. Attrition was especially noticeable on the anterior teeth on the right side.

Figure 7 illustrates the influence of a restoration on the movement pattern and on occlusal changes. Before the placing of the restoration, the occlusal conditions were similar on both sides, and bilateral movements predominated. Soon after the restoration was placed, the movement pattern changed so that unilateral (left) movements predominated. The restoration created a steep path for right lateral movements with contact only on the left posterior teeth. During the 11 years following placement of the restoration the changes taking place were in accordance with unilateral movements. Thus, attrition occurred only on the left anterior teeth.

From the study of dentitions with extractions and restorations, the following general observations were made: On the first examination dentitions of this type show a pattern of movement that appears to be influenced by the original position and occlusion of the teeth; the changes seem to be related to the predominant gliding movements. As a result of extraction, the dentition undergoes familiar changes, such as extrusion of the teeth without antagonists, tipping and occasionally intrusion of some teeth. These changes result in alteration of the inclination—often a steepening—of the gliding path. Likewise the number of teeth making contact in eccentric positions is changed. The individual movement patterns also generally appear reduced. For instance, a bilateral movement pattern may become unilateral. After the loss of several teeth, often all movements are restricted, and a locked bite results. The

12. Thielemann, K. Biomechanik der Paradentose. Leipzig, Meusser, 1938.

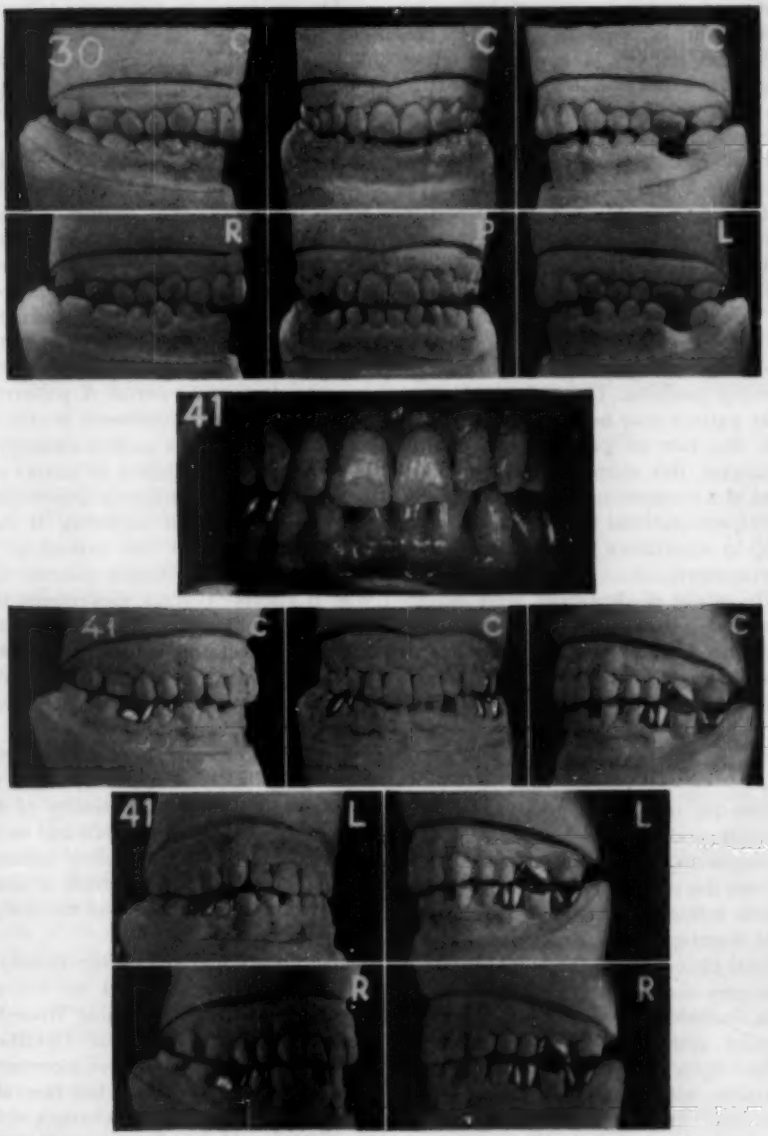

Fig. 7 • Dentition with restoration. Before restoration bilateral movements predominated. Eleven years after restoration was placed (30-41 years), unilateral (left) movements predominated; in right lateral movements there was a steep path and contact only on left posterior teeth. Note attrition on left anterior teeth only

continued occlusal changes appear to develop in accordance with the new movement pattern. The changes occurring after extraction are difficult to follow since secondary changes due to altered function are superimposed on the primary changes brought about by loss of teeth. Extraction generally leads to dysfunction and this in turn to unfavorable forms of occlusion.

A restoration—bridge, crown or filling—likewise leads to a transformation of the original dentition; the inclination of the gliding paths is often changed and also the number of teeth in contact in eccentric positions. The individual movement pattern may be altered; compared with the rate of pattern change after extraction, this change after the placement of a restoration occurs very rapidly. Subsequent occlusal changes seem to develop in accordance with the new movement pattern.

The study of dentitions with extractions and restorations bears out the observations of the main investigation in regard to reciprocal effect between the occlusion and the movement pattern.

SUMMARY AND CONCLUSIONS

Present-day opinions of the development of adult occlusion are based on single investigations which reveal the final result and not the course of the changes or the factors influencing them. Therefore, a serial investigation was conducted of the occlusal changes that the adult dentition undergoes during a period of 8 to 12 years. Included in the study were 44 complete or almost complete dentitions of various types. In a supplementary study dentitions with extractions and restorations were observed in a similar manner. The methods of investigation used were (1) oral examination of the occlusion, (2) analysis of occlusion in an adjustable articulator and (3) study of the mandibular movements. The procedure was repeated at intervals of two or three years.

The investigation led to the following conclusions:

1. Occlusal changes appear to develop in accordance with the individual pattern of gliding movements with the teeth in contact.

2. Occlusal changes consist of attrition, tipping and migration of teeth. The form and localization of these changes are alike in dentitions with the same movement pattern. Movement patterns are of four types: (1) multidirectional gliding movements, (2) predominating bilateral movements, (3) predominating sagittal movements and (4) predominating unilateral movements. A pattern of entirely restricted movements is rare.

3. The movement pattern seems to be governed to a high degree by factors pertaining to the teeth and primarily by their original position and occlusion. If these factors are altered by extraction or restoration, the movement pattern likewise is altered. Gliding movements that must follow a steep path and have few teeth in contact are avoided or restricted, whereas movements that follow a fairly flat path with several teeth in contact are preferred and predominate.

4. The significance of occlusal changes is of special interest with respect to the stress on the supporting tissues of the teeth. The changes in position and occlusion of the teeth are favorable or unfavorable according to the direction of stress, the distribution of stresses and the character of the movements.

Multidirectional gliding movements in a dentition seem to lead to occlusal changes which are favorable from the viewpoint of occlusal stress. Dentitions with predominating bilateral movements seem to have a somewhat less favorable development. The occlusal changes which occur in dentitions where sagittal movements predominate and especially where unilateral movements predominate and other movements are restricted seem to produce unfavorable occlusal stress.

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COUNCIL ON DENTAL HEALTH

The role of dentistry in chronic illness

Chronic illness has been defined by the Commission on Chronic Illness as an impairment of bodily structure or function, or both, that has persisted or may be expected to persist over an extended period of time.[1]

There are three distinct relationships between dentistry and chronic illness:

1. Many general pathological conditions with manifestations in the mouth may be discoverable first in the course of dental examinations, interviews or treatment. Thus, dentistry has an important role in the detection, control or correction of numerous chronic diseases and impairments.

2. Persons with chronic illness require dental care. A serious problem exists in providing dental care to the bedfast patient.

3. Many dental conditions may become chronic. If uncorrected, they may cause chronic impairment of various functions. Such impaired functioning, in turn, often may be a factor in disease.

Before these relationships are discussed in detail, it would be well to have a general view of the over-all problem of chronic illness.

PREVALENCE OF CHRONIC ILLNESS

The present large size and growing proportions of the chronic illness problem challenge all health professions to make every possible contribution toward chronic disease control. According to the findings in the National Health Survey of 1935-1936[2] and corroborative facts from later studies, the following estimated percentages of the major age groups of the population have chronic disease conditions:[3, 4]

Of those—

65 years and older . . . . . .50 per cent
45-64 years . . . . . .30 per cent
15-44 years . . . . . .15 per cent
Under 15 years . . . . . 5 per cent

Economic and medical care implications of the chronic illness load are pithily expressed in a 1951 booklet of the U. S. Public Health Service as follows:[5]

1 million deaths a year from chronic diseases
1 billion man days lost a year from chronic diseases
1/6th of the population chronically ill at all times
5 out of 6 hospital beds occupied by the chronically ill
½ of the chronically ill are under 45 years of age

1. Commission on Chronic Illness. Preliminary model community survey of local chronic illness facilities and services. September 1951, 12 p. (Mimeographed).

2. U. S. Department of Health, Education and Welfare, Public Health Service, National Institutes of Health. National Health Survey, 1935-36. The magnitude of the chronic disease problem in the United States. Preliminary reports, sickness and medical care series, Bulletin No. 6. Washington, D. C., 1938 (Rev. 1939). (Processed).

3. Lawrence, P. S. An estimate of the incidence of chronic disease. Pub. Health Rep. 63:69 Jan. 16, 1948.

4. Downes, Jean. Findings of the study of chronic disease in the eastern health district of Baltimore. In New Steps in Public Health; Twenty-Second Annual Conference of the Milbank Memorial Fund, April 12-13, 1944, Vol. 2. New York, Milbank Memorial Fund, 1945, p. 1-15.

5. U. S. Department of Health, Education and Welfare, Public Health Service. Chronic disease—long term illness. Publication No. 2. Washington, D. C., Government Printing Office, 1951.

INCREASING VOLUME OF CHRONIC ILLNESS

As communicable diseases are brought under control, the scope of chronic diseases becomes more pronounced. Comparisons of the ten leading causes of death in 1947 with those for each decennial year show great reduction in mortality from infectious and communicable diseases and a corresponding increase in mortality from chronic diseases.[6] Also, for the future, the chronic illness prospect is even more serious because of the increasing number and proportion of aged persons in the population.

In 1900, about three million persons in the United States were 65 or older, or approximately 4 per cent of the population; in 1940, about nine million men and women, or 8 per cent of both sexes. In 1975, the group aged 65 and older will number 20 million persons and will represent nearly 11 per cent of the population, according to estimates by national authorities cited in a paper presented at the Second Gerontological Congress in St. Louis in 1951.[7] Several passages in the summary of the paper have been selected for quotation here in order to delineate briefly the increased volume of chronic illness expected for the future and to emphasize the importance of chronic disease control through all possible means:

> Aging of the population will materially affect the extent and types of disabling illness in the population and will also increase the volume of services furnished by physicians, nurses, hospitals, and other health personnel and facilities. The latter observations are based on conspicuous differences between the old-age group and the population as a whole as found in surveys of illness and receipt of medical and other health services. . . .
>
> Projecting the findings of the National Health Survey of 1935-36 and of the Baltimore study of 1938-43 to future years, it is estimated that the number of disabling illnesses in the United States lasting seven consecutive days or longer will be 25-30 per cent higher in 1960 and 40-50 per cent greater by 1975. Total annual days lost from disability are expected to rise 30 to 40 per cent by 1960 and even more by 1975. These anticipated increases in disability will not only result from the larger size of the population, but will also reflect the future rise in number and proportion of older people in the population—in age groups that show the highest rates of chronic illness. . . .
>
> Control of the chronic diseases—perhaps by early detection in the middle years or before—and prevention or amelioration of their consequences would greatly reduce not only the time lost from disability but also the patient load on hospitals, nurses, and physicians.[8]

PRIMARY CAUSES OF DISABILITY; PERSONS AFFLICTED

In the National Health Survey, it was found that for all persons who were disabled a year or longer immediately preceding interview, the primary causes included the following in the approximate percentages of total cases as shown:[9]

Rheumatism or arthritis, about	10%
Permanent results of accidents, about	9%
Tuberculosis, all forms, more than	5%
Diseases of digestive system, nearly	5%
Cancer and other tumors, about	2%

Within these categories and also within some of the other classifications are numerous conditions that are detectable, controllable, ameliorable or correctable through dentistry.

Data of a similar type, although somewhat differently classified, have recently

6. Department of Health, Education and Welfare, Public Health Service, National Office of Vital Statistics, United States, summary of vital statistics, 1947. Vital statistics—special reports: state summaries 30:1 Sept. 15, 1949. (Processed).

7. Perrott, G. St. J.; Goldstein, Marcus S., and Collins, Selwyn D. Health status and health requirements of an aging population. In Illness and health services in an aging population. Public Health Service, Division of Public Health Methods, Publication No. 170. Washington, D. C., Government Printing Office, 1952.

8. Perrott, G. St. J.; Goldstein, Marcus S., and Collins, Selwyn D. Health status and health requirements of an aging population. In Illness and health services in an aging population. Public Health Service, Division of Public Health Methods, Publication No. 170. Washington, D. C., Government Printing Office, 1952, p. 21-23.

9. Based on Britten, Rollo H.; Collins, Selwyn D., and Fitzgerald, James S. The national health survey, some general findings as to disease, accidents, and impairments in urban areas. Table II. Pub. Health Rep. 55:460 March 15, 1940.

become available from a Social Security Administration study in mid-1951 of the major causes of disability of recipients of Aid to the Permanently and Totally Disabled. The program of aid to this category of recipients was started in October 1950 under the 1950 amendments to the Social Security Act. At the time of the study, 30 states had programs in operation, and the recipients numbered more than 90,000.[10] Most of them were in late middle life, the median age being 55 for men and 57 for women. Eighty-five per cent of the recipients were 40 or older, but only 3 per cent were 65 or older as the latter group is aided through Old Age Assistance, a separate program.[11]

DENTAL ASPECTS OF SPECIFIC CHRONIC ILLNESSES

Many of the major chronic illnesses have direct implications in dental health and manifestations in the oral cavity. Some of the diseases and their relationship to dentistry follow:

Diabetes Mellitus • Diabetes may manifest itself in the oral cavity by an effect on the periodontal structures and the oral mucosa. The alveolar bone becomes atrophied and the periodontal disease varies in extent, depending on the severity of the diabetes and the duration of the disease before treatment is instituted. Diabetics require frequent dental attention, for if the dental conditions are ignored or if control measures are not instituted early enough, the periodontal disease itself may become a chronic illness.

Cancer • An estimated 10 per cent of all cancers in men and 2 per cent of all cancers in women occur in the oral cavity, which includes the lips. Particularly in oral cancer does prevention of fatalities through early discovery of cases and referral for suitable treatment rest with dentists. Aside from the fact that many individuals visit their dentists regularly, the majority of persons with oral symptoms consult their dentists rather than their physicians. Data from one large hospital showed that 60 per cent of patients with oral cancer had consulted a dentist first.[12]

The dentist should be alert constantly for cancer symptoms and refer suspected cases to qualified specialists in the diagnosis and treatment of neoplastic disease. Caution must be observed in extractions after radium therapy.

The dentist also has a major role in keeping the oral cavity clean in cases of terminal carcinoma and in controlling foul odors, secondary invaders and pain. Without such care, the oral cancer patient is unable to eat and weakens rapidly. The need for somatoprosthesis in the rehabilitation of the patient after surgical removal of facial parts is increasing yearly.

Mental Illness • It is sometimes difficult for the dentist to treat mental patients because of their inability to cooperate. Dental treatment for some mental patients must be performed under general anesthesia.

Epilepsy • The dental concern in epilepsy is related principally to bruxism and to the importance of the avoidance of the use of removable bridges and dentures because of the hazard of their becoming lodged in the throat during an epileptic seizure. When Dilantin (diphenylhydantoin sodium) is used in therapy, the drug frequently is associated with considerable gingival hyperplasia. Other diseases of the nervous system have direct dental impli-

10. Hawkins, Charles E. Aid to the permanently and totally disabled recipients with heart disease. Social Security Bulletin 16:3 July 1953.

11. U. S. Department of Health, Education and Welfare, Social Security Administration, Bureau of Public Assistance. Characteristics of recipients of aid to the permanently and totally disabled mid-1951. Public Assistance Report No. 22, April 1953, p. 10.

12. Lloyd, R. S. Role of the dentist in oral cancer detection. Pub. Health Rep. 63:805 June 18, 1948.

cations, such as the various neuralgias of the oral and facial region.

Cerebral Palsy • It has been estimated that there are 170,000 children with cerebral palsy in this country.[13] It appears that these patients are among the most dentally neglected of any group of children, largely because of the difficulties that are encountered in the provision of dental care either by the dentist or through routine personal hygiene measures. The incidence of dental diseases is not believed to be higher than in other children, but the dental neglect which leads to infection and loss of teeth is of special concern to the dental profession.

Cardiovascular Diseases • Among cardiovascular diseases, subacute bacterial endocarditis has the most direct relationship to dental operations. Much evidence indicates that this disease can be caused by transient bacteremias from infected teeth, particularly during tooth extractions. It is especially important that extra precautions be taken with cardiac patients during dental operations. Sometimes problems arise in regard to the use of anesthesia in a patient with cardiovascular disease. The local use of epinephrine in such patients raises a problem.

Arthritis • Although many opinions based on clinical observations have been expressed regarding the relationship between rheumatoid arthritis and oral foci of infection, a critical review of the literature indicates that a direct causal relationship has not been established by scientific studies. All clinicians agree that, for the purpose of general health, definite oral foci should be removed under any circumstances. However, the reported relief of arthritis directly as the result of dental procedures—as in the case of removal of suspected oral foci—is not accepted as complete evidence of cause and effect by the majority of investigators. One of the specific concerns of dentists in regard to arthritis relates to problems of mastication. The dentist assists in the control of pain from arthritis of the temporomandibular joint, and makes provision for improved mastication where the range of motion is limited.

Cleft Palate • Cleft lips and palates, singly or in combination, are the most frequently found congenital deformity, occurring once in about every 700 live births.[14] This deformity is also one of the most frequently neglected and requires the services of many specialists for correction and rehabilitation. The dental specialties serve a highly important function in the care of patients with this deformity. In fact, the dentist is an essential member of the necessary team which analyzes the problem of a patient with a cleft palate and designs the plan for his rehabilitation.

Tuberculosis • Tuberculosis sometimes affects the oral cavity, one of the more common conditions being tuberculosis of the tongue. The recovery of patients from tuberculosis is dependent in large part on the improvement of the general health. Certainly, the removal of dental infections is an urgent requirement in the treatment of the tuberculous patient. It is highly important that the patient's dental health be such that he is comfortable, that he is able to masticate the foods necessary to his recovery during hospitalization and that he is able later to select foods on the basis of their nutritional value rather than on his ability to chew them properly.

Addison's Disease • The pigmentation of the oral mucosa sometimes may lead a dentist to suspect Addison's disease before dermal pigmentation occurs, and the den-

13. Lyons, D. C. Dental problem of the spastic or the athetoid child. Am. J. Orthodont. 37:129 Feb. 1951.

14. Cooper, H. K. Integration of services in the treatment of cleft lip and cleft palate. J.A.D.A. 47:27 July 1953.

tist can help by referring such cases to the physician. Dental infections and surgical procedures may precipitate an adrenal crisis; therefore, dentists need to be alert to the precautions that must be taken in caring for patients with this disease.

Nutritional Disorders • Severe cases of nutritional disorders are extremely obvious, and the victims are thus forced to recognize the necessity for medical attention. The dentist with his opportunity to examine periodically the oral cavity and surrounding structures should be alert for symptoms of a nutritional nature. The gingival tissues, in particular, reflect various deficiencies, as do sore tongue, red and magenta tongue, atrophy of papillae and excrescences at the corner of the mouth.

CHRONIC ASPECTS OF DENTAL DISEASES AND CONDITIONS

Although dental diseases and conditions, in themselves, seldom are listed among the chronic illnesses, there are chronic factors related to many of them:

Dental Caries • The chronic aspects of dental caries have long been recognized because the disease is not self-limiting. If not cared for, dental caries practically invariably leads to pulpitis which is followed by either an acute periapical abscess or a chronic periapical granuloma, and, eventually leads to the loss of the tooth. The loss of one tooth, in itself, if the tooth is not replaced, in time may result in further disease conditions of a chronic nature, such as a rearrangement of adjoining and opposing teeth and periodontal disturbances. Dental caries is almost universal, affecting at least 95 per cent of the population.

Dental Fluorosis • Where drinking water supplies contain fluorides in excess of 1.5 ppm (or a lower ratio in areas where water consumption is high), a mottling of the enamel known as endemic dental fluorosis becomes a problem among those persons who had consumed the water during the years in which their dental enamel was being formed. Severely hypoplastic enamel becomes stained, and the teeth are more subject to fracture than teeth which are not so affected.

Gingivitis • There are several forms of gingivitis, and it is one of the most common chronic diseases of the oral cavity. One study of nearly 9,000 school children in suburban Chicago indicated that gingivitis occurs in some form in as high as 56 per cent of six year old children and 83 per cent in the 11 year old group (the period of mixed dentition).[15] A study of over 4,000 Navy personnel (males—age 17 to 21) showed that 66 per cent were affected by gingivitis.[16]

Advanced Periodontal Disease • This disease, commonly called pyorrhea, usually originates as gingivitis, and as the inflammation spreads from the gingival to the periodontal tissues, the alveolar bone becomes resorbed to the extent that eventually the teeth are lost if prompt treatment is not instituted. The prevalence of the disease has not been measured, largely because of inadequate measuring devices. It is well known among dentists, however, that most of the teeth lost after the age of 35 are lost as a result of advanced periodontal disease, a truly chronic disease of the oral cavity.

Vincent's Disease • Vincent's disease occurs most frequently in the gingival tissue, although it also may attack other parts of the mouth and throat. Although the acute disease usually is recognized by the

15. Massler, Maury; Schour, Isaac, and Chopra, Baldev. Occurrence of gingivitis in suburban Chicago school children. J. Periodont. 21:146 July 1950.

16. Massler, Maury; Ludwick, William, and Schour, Isaac. Dental caries and gingivitis in males 17-20 years old (at the Great Lakes Naval Training Center). J.D. Res. 31:195 April 1952.

patient and relief from pain is sought, interruption of treatment before the infection is eliminated results in a chronic condition.

Malocclusion • Several investigators have reported on the prevalence of malocclusion,[17,18] but more effective and standardized methods of appraising malocclusion are needed before general statements can be made as to the number of people so afflicted and the extent of their affliction. The deformity, in the majority of instances, can be labeled chronic since relatively few persons, especially among the adult population, are benefiting from corrective procedures.

Oral Manifestations of Diseases of Occupational Origin • Diseases associated with a person's occupation frequently are chronic in character. Some are due to direct action of the occupational causative agent on oral structures, some affect oral structures as a result of a systemic disturbance. The principal causative factors are absorption of metals and some nonmetallic and organic substances; abrasive action on teeth as in the case of glass blowers; corrosive or caustic action from chemical fumes, and increased susceptibility to dental caries among some confectionery and bakery workers.

PREVENTION OF DENTAL CHRONIC ILLNESS

Most dental diseases can be prevented from becoming chronic. Malocclusion caused by premature loss of teeth and undesirable habits can be prevented, and malocclusion that is hereditary in origin usually can be controlled. Dental fluorosis can be prevented by a change in the water supply or through a treatment process to remove the excess fluorides from the water. Chronic gingivitis can be prevented through hygienic measures and the removal of predisposing factors.

Advanced periodontal disease, at least that which is local in origin, can be prevented, largely through proper control during early stages. Because of the lack of information about the etiology of periodontosis, however, preventive measures are not well defined.

The chronic phases of Vincent's disease can be prevented through early and complete treatment of the acute condition. Growth patterns that result in malocclusion, even those that are of a hereditary nature, can be interrupted and changed at the appropriate time and with proper treatment need not become "chronic." Many of the changes related to senescence that result in loss of function can be prevented or largely alleviated by timely and adequate treatment so that the changes need not necessarily contribute to a chronic condition. It is obvious that dental conditions resulting from occupational situations can be prevented through proper precautions in the working environment.

Dental caries can be prevented to a significant extent through the use of fluorides and restriction of sweets in the diet and can be controlled by early restoration of carious teeth. The prevention of dental caries will result in prevention of pulpitis and periapical infection with the minor exceptions of pulp and periapical disease resulting from traumatic exposure of the pulp or to embolic infection by way of the blood stream.

DENTAL ASPECTS OF PREVENTION RELATED TO CHRONIC ILLNESS

There are some instances in which dentistry can be especially important in the preventive aspects of chronic illness. A relatively large percentage of oral cancers and of other external cancers fall within the surveillance of dentists. Dentists

17. Wertheimer, Fred, and Donnelly, C. J. A study of the dental conditions of 7,373 Michigan children. J. Michigan D.A. 34:26 Feb. 1952.

18. Pelton, W. J., and Elsasser, W. A. Studies of dentofacial morphology. III. The role of dental caries in the etiology of malocclusion. J.A.D.A. 46:648 June 1953.

trained and experienced in the recognition of suspected symptoms, not only in the mouth but on most exposed surfaces of the dental patient's body, are in a position to refer such patients to properly qualified specialists for early diagnosis and treatment. Of patients with oral cancer seen at one large hospital several years ago, 60 per cent reported they had first seen a dentist, but only 38 per cent of the cases were suspected by the dentist to have cancer.[18] Postgraduate training programs for dentists in oral cancer detection have been in operation in many states during the past several years, however, and cancer teaching in dental schools has improved considerably; therefore, it is assumed that dentists are accepting more and more their responsibilities in this important field.

Physicians who are responsible for the care of patients with tuberculosis always stress the importance of dental care in aiding recovery. Many hospitals for patients with tuberculosis do not have adequate dental facilities, although the number which do have is increasing gradually. There is the problem of competent staffing, however, which will be discussed in another part of this report.

Dentists are becoming increasingly alert to their responsibility to patients with cardiovascular disease, especially in view of the established relationship between subacute bacterial endocarditis and dental infections.

Dentistry plays a major role in surgical correction, in the guidance of oral development, and in the construction of appliances for persons with cleft palate. Continuing dental care for these persons is especially important if they need to wear appliances that require anchorage to the teeth.

In all forms of chronic illness, dental services are an important part of the health care necessary for the prevention, correction and control of the illness and the maintenance of good health. The removal of all infection from the mouth and the establishment of functional occlusion so as to allow patients to eat proper foods are highly important in the treatment of persons with chronic illnesses. Rehabilitative services for patients with chronic illness frequently require dental corrections to maintain dental health and functional occlusion and to restore facial esthetics.

DENTAL PERSONNEL NEEDS

Many patients with chronic illness are cared for in hospitals and other institutions. There is a serious shortage of dentists who enjoy doing institutional work; also, the low salary frequently offered is a deterrent to the acceptance of institutional positions. Institutions for the care of patients with tuberculosis and mental illness, for example, have special difficulties in finding dentists who are willing to work in a communicable disease environment or in mental institutions where patients oftentimes are unable to cooperate. Highly specialized skills are required for the care of patients with cleft palate. Relatively few dentists find it possible to care for patients with cerebral palsy in their dental offices; moreover, under any circumstances, special skills are necessary for the proper dental treatment of such persons.

There is a need for increased training of all dentists in the recognition of early symptoms of general chronic illnesses and in the special care required by some persons so afflicted. Such training should include clinical observations and should be continued through the dentist's professional career. Special postgraduate courses for dentists in the area of chronic illness might prove to be profitable in helping relieve the general problems of chronic illness in the nation.[19] The dental internship and residency programs being promoted by the American Dental Associa-

19. News of dentistry. Connecticut dentists learn care of cerebral palsied. J.A.D.A. 41:742 Dec. 1950.

tion will help much in training more dentists in areas related to the care of the chronically ill. (See section on integration of services.)

METHODS OF PROVIDING DENTAL CARE

Most large hospitals have dental facilities for the care of patients served in the hospital. One survey of hospitals of all sizes indicates that about two out of seven hospitals have dental facilities.[20] Hundreds of small hospitals, homes for the aged, nursing homes, and similar institutions, however, have no facilities for the provision of dental services and, frequently, have no regularly established arrangement for referral of patients for dental care or provision for visits by dentists to the institution. One of the most serious problems associated with this situation is the apparent lack of appreciation by the administrators of these institutions of the need for dental services for their patients. For example, in a survey of 90 nursing homes with 1,555 patients in Colorado,[21] reports obtained from the persons in charge showed that only 12.5 per cent had unmet dental needs. This figure is not at all comparable to what a dentist would find on examination of these patients.

An estimate of the dental problems in the nursing homes of one large city[22] listed the following most common complaints:

1. Fractured teeth or roots that need extracting.
2. Fillings that need to be replaced.
3. Inflamed or chronically tender gingiva that should be treated.
4. Dentures that need to be rebased, repaired or replaced.
5. Palliative treatment, at least, for untreated and painful defects.

Many institutionalized patients are unable to go to the dentist's office, and many are unable to assume other than a prone position.

Although most dentists, on request, will make home calls to relieve painful and infectious conditions for persons unable to go to a dental office, the dental care of hundreds of persons confined to their homes is extremely limited because of a lack of organized facilities to provide such care. In a few communities it has been reported that portable dental equipment has been provided for the use of dentists when they make home calls, and in other areas, dental societies have provided lists of dentists who have indicated a willingness to make necessary home calls.

A service that could be instituted by a community health council, a local health department, or some other interested group, would be the organization of methods for providing dental services for institutionalized persons and for persons confined to their homes. Moreover, the availability of these services should be made known among potential users. Steps that might be taken are the purchase of portable dental equipment and the calling together of dentists, dental hygienists and other interested persons who would provide the dental care to the confined patients. Dentists who are willing to provide these services would have an opportunity to make this fact known to the responsible voluntary or official health group, and a routine referral system could be established. In some instances, provision might need to be made for the financing of these services. The local agency which assumes the responsibility for care of these patients should work closely with the local dental society.

In one medium-sized community, a local service organization financed the purchase and installation of dental equipment in a small hospital specifically to

20. Hospitals. Administrators' guide issue. Part II. Vol. 27, June 1953.

21. Colorado State Department of Public Health, Research and Reports Service. Progress report and preliminary statistics on the Colorado survey of nursing home patients, June 25, 1953. (Processed).

22. Personal communication from Edna Burke, nursing consultant, City and County of Denver, to Robert A. Downs, Colorado State Health Dept., Jan. 27, 1954.

provide dental care for the children with cerebral palsy in that area, and other local organizations joined in helping to underwrite the cost of the dental care program.

INTEGRATION OF DENTAL SERVICES WITH OTHER HEALTH SERVICES

The dental profession, through its undergraduate and graduate teaching programs and through direct activities at the community level, is promoting more extensive integration of dental services with those of other health professions. The American Dental Association promotes such integration through the establishment of standards for hospital dental services, the promotion of dental service units in hospitals, the establishment and approval of dental internship and residency programs in hospitals and participation in the work of the Commission on Chronic Illness.

The first two paragraphs of the Association's *Basic Standards of Hospital Dental Service*[23] explain the dental profession's concern for the integration of dental care in the provision of total health services for individuals:

> The dental profession believes that the health care it renders is an essential part of a total health service. It has long recognized as well, that its services must be well integrated with those of the other health professions in order to provide this total health service for the individual patient. The modern hospital, marshalling as it does many professions, services and facilities, provides a great challenge and opportunity for inter-professional cooperation in the service of the individual patient.
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> For these reasons, the American Dental Association has established the Council on Hospital Dental Service as its agency to aid in the improvement of dental services in the hospital. The Council on Hospital Dental Service examines dental services in hospitals and issues certificates in the name of the American Dental Association to hospitals which have dental services which meet certain standards.

At the present time, 373 hospitals in the United States have applied for and received approval for their dental service programs. Forty-six of these hospitals are for "long-term" patients. Their services, developed in consultation with the American Dental Association, provide adequate dental care for hospitalized patients. Some programs that demonstrate a highly developed interprofessional approach include services for persons with cleft palates and with malignancies directly related to the oral cavity.

The Association's Council on Hospital Dental Services is now embarking on an informational program among the nation's hospitals to advise them of the need for integration of dental services with the services of other health professions.

The Association, through its Council on Dental Education, promotes the establishment of and approves dental internship and residency programs in hospitals. To date, the Association has approved nearly 200 dental education programs in hospitals, and it is estimated that there are an additional 200 that have not yet been evaluated by the Association. These programs are designed primarily to provide advanced education in the dental specialties, but some of the programs include advanced training for the general dental practitioner. This education extends the training of the dentist beyond that provided in dental schools and enables him better to integrate his services with those provided by other members of the hospital health team.

SUMMARY

1. The problems of chronic illness are growing, particularly in view of the increasing proportion of older persons in the population. Chronic diseases have long been considered by the public to be rather hopeless, but the health professions are now proving that this conception is erroneous.

23. Council on Hospital Dental Service and Council on Dental Education. Dental programs for hospitals. Chicago, American Dental Association, 1953.

2. Chronic illness contributes in large part to the nation's death rate and disability problems. Prevention and control are possible, and thousands of people can be returned to productive employment.

3. Many of the major chronic illnesses manifest themselves in the mouth and therefore have direct implications in the field of dentistry. Among these illnesses are diabetes mellitus, cancer, mental illness, epilepsy, cerebral palsy, cardiovascular diseases, arthritis, cleft palate, tuberculosis, Addison's disease, and nutritional disorders.

4. Many dental diseases and conditions actually are or may become chronic unless timely treatment is instituted. Among these conditions are dental caries, dental fluorosis, gingivitis, advanced periodontal disease, Vincent's disease and malocclusion.

5. Most dental diseases can be prevented from becoming chronic.

6. Dental care is especially important in the preventive and rehabilitative aspects of chronic illness, particularly in the early detection of cancer, in the recovery of patients from tuberculosis, in the prevention of the onset of bacterial endocarditis and in the care of persons with cleft palates.

7. There is a shortage of dentists who are well qualified and willing to work in institutions that care for the chronically ill. Recognition of the importance of adequate dental care and the willingness to pay adequate salaries for properly trained and qualified personnel will help this situation.

8. Community groups can do much to help find methods for the provision of dental care for persons with chronic illness, particularly for those in small institutions and private homes who are unable to go to the offices of private dentists or to outside dental clinics.

9. The American Dental Association, through its hospital accreditation program and its dental internship and residency program, is promoting the provision of more facilities and the training of more dentists for the care of persons with chronic illness.

RECOMMENDATIONS

1. More dental research should be devoted to methods of measuring the extent of periodontal disease and malocclusion in order that their epidemiological characteristics may be studied and possible control measures suggested.

2. More dental research should be directed toward the etiology and control of periodontal disease.

3. Public health agencies should conduct field studies that would lead to the development of public health methods for the prevention and control of periodontal disease and malocclusion.

4. Community dental health programs should be greatly expanded and should include dental health education, the promotion of early and periodic dental examination and care and the application of effective preventive measures for the control of dental disease.

5. Community groups should be urged to include the provision of dental services in their planning for the care of persons with chronic illness.

6. Undergraduate and postgraduate programs should be expanded so that dentists will develop a fuller appreciation for the dental and related health needs of persons with chronic illness and will learn the skills that will enable them better to recognize early symptoms of chronic illness.

7. Additional hospitals should be apprised of the need for adequate dental services for their patients. An informational program is needed to help all those who are responsible for the care of persons with chronic illness to recognize the importance of regular dental care for their patients.

8. Dental societies at the state and local levels should stimulate and work with voluntary and official agencies in

the development of programs that will provide adequate dental services for persons who are chronically ill. It should be emphasized that all aspects of community dental health programs that lead to the prevention and control of dental diseases lead also to the prevention and alleviation of chronic illnesses and disabilities.

COUNCIL ON LEGISLATION

Association testimony on bills relating to the President's health program

On April 14 Floyd W. Pillars of Des Moines, Iowa, a member of the Council on Legislation, presented the following testimony to the Senate Committee on Labor and Public Welfare. Dr. Pillars was accompanied by Mr. Francis J. Garvey, secretary of the Council. In his testimony Dr. Pillars discussed bills relating to the President's health program. On behalf of the Association he endorsed the proposed revision of the grant-in-aid program for health; suggested amendments to the Medical Facilities Survey and Construction Act to bring the practice of dentistry within its terms, and recommended that the Congress take no action on the Reinsurance Bill during this session so as to give all interested persons an opportunity to study the proposal.

My name is Floyd W. Pillars. I am a dentist engaged in the practice of oral surgery in Des Moines, Iowa. I appear before you this morning as a member of the Council on Legislation of the American Dental Association to present the views of that organization with respect to a number of bills contained in the President's health program. With me is Mr. Francis J. Garvey of Chicago, secretary of the Council, who will assist me to answer any questions you may have.

You have requested the Association's views on five bills. May I say immediately that the Association has no comment to offer on S. 2759. I should like, with your permission, to divide the balance of the bills into three groups and to discuss each group in its turn. My groups are these: (a) S. 2778 and H.R. 7397 dealing with the grant-in-aid program; (b) S. 2758 and H.R. 8149, the proposed Medical Facilities Survey and Construction Act of 1954; and (c) S. 3114 and H.R. 8356 which propose the establishment of a system of reinsurance in the health field.

Before discussing the bills, let me refresh your memory with a few facts about dental health and the dental profession. The problems relating to oral health in this country affect nearly every individual. About 95 per cent of the population will, at some time during their lives, experience dental decay. This disease manifests itself in children as young as two years of age. It is a disease from which the patient neither dies nor recovers. The carious lesions remain until treated. If they are neglected, the affected tooth will be lost. In addition to dental decay, about 80 per cent of the population over 30 will experience some form of periodontal disease, commonly called "pyorrhea" by laymen. It, too, requires considerable treatment and, if neglected, may not only result in the loss of teeth, but may prove a source of other infection. Loss of teeth is a condition with which almost everyone is familiar and it is safe to say that at least half of the population over 50 requires some form of denture to replace natural teeth which are missing. Other problems in the dental health field include cleft lip and palate and disfiguring malformations of the jaws.

The care and study of these diseases are the responsibility of the dental profession, a group which is part of the health team but which is independent of all other professions, having its own schools, its own literature and organization, and its own licensing system in each of the states. Within his field the dentist, as an independent consultant or operator, cooper-

ates with members of other health professions in the solution of health care problems requiring their combined knowledge and skills.

The recognized spokesman of the dental profession is the American Dental Association. There are in the United States today about 83,000 dentists engaged in active practice. More than 84 per cent of these are members of the Association. Policies of the Association are adopted by its House of Delegates, a representative body chosen from among the membership of the constituent and component societies located in each of the 53 states, territories and possessions of the United States. These policies are adopted after the area in which a pronouncement is made has been carefully studied by one or more of the Councils (or standing committees) of the Association and a recommendation growing out of such studies has been presented to the House of Delegates.

The first proposition I propose to discuss is the revision of the grant-in-aid formula. As you know, S. 2778 (H.R. 7397), if enacted, would eliminate the five categorical grants now specified in the Public Health Service Act, substituting therefor a single-grant fund to which the states would have access, on a matching-fund basis, for any programs in the health care field which they might care to justify to the Surgeon General. They would not be prohibited from seeking funds in the areas now covered by categorical grants, but they could likewise ignore these areas and secure assistance in fields which might be more important to their particular needs at a given time.

Last year, according to the federal budget, some 58 million dollars was appropriated in the five categorical fields against 13 million dollars for assistance to the states for all other problems of health care. The obvious disproportion indicates the persuasive effect which the availability of federal funds in categorical areas has had on state programs. To the American Dental Association it appears to be in the general interest to provide a single fund of adequate amount from which each state could obtain necessary assistance for its particular needs without being influenced by the availability of categorical money and the paucity of funds for general grants.

In the past grants for dental health programs have not been available through Public Health Service grants. Rather, state programs in this area have been maintained through the Children's Bureau Maternal and Child Health programs. In view of the prevalence of dental disorders, and the obvious need for expanded state programs in the field of dental public health, the Association believes that enactment of the new formula and elimination of the categorical grants would stimulate sound programs in fields of health which are important to the welfare and comfort of the individual, but which are neither so dramatic nor appealing as the killer diseases such as cancer and heart ailments, or those which cause the removal of the individual from society such as tuberculosis and mental disorders.

The House of Delegates of the Association long ago adopted the following policy:

"Grants-in-aid should be considered as an acceptable method of supporting state dental health programs, provided that the right of a state to adapt a program to meet its own needs is safeguarded."

In the light of that policy, the Association recommends the enactment of S. 2778.

The second proposition to be considered is that expressed in H.R. 8149. Two things are included in this bill: (a) a program to survey the need of the states for diagnostic and treatment centers, chronic disease hospitals, rehabilitation facilities and nursing homes; and (b) provision of funds under a matching formula to construct the facilities found to be needed.

The dental health interest in this bill can be found on two pages: 14 and 15. On page 14, beginning at line 17, "diagnostic and treatment centers" are defined. They are said to be facilities for the diagnosis or treatment of ambulatory patients. Taking the definition this far, it fits admirably the average dental patient, since dental care necessarily involves both diagnosis and treatment and relatively few dental patients are not ambulatory. However, at line 22, the advantage of such facilities as providers of additional dental health care is severely limited by the phrase "in which patient care is under the professional supervision of persons licensed to practice medicine and surgery in the state." Earlier, I explained that the profession of dentistry was a profession independent of medicine, that the two worked conjointly on mutual problems but in an equal, not a subordinate, status.

The language used in this section tends to eliminate the possibility of establishing dental facilities under the bill. These facilities are needed in conjunction with such over-all medical facilities as diagnostic centers, but they should be under the direction of a licensed dentist. This can be accomplished by rewriting line 24 of page 14 to read:

"medicine, surgery or dentistry in the state."

Today, every dental school in the country operates a diagnostic and treatment center in its teaching clinic. If the Senate were to adopt the suggested amendment, it would be possible to enlarge and expand such clinics with a

two-fold benefit: (a) more patients could receive dental health care because of the existence of the additional facilities; (b) dental schools could train more dentists by reason of the expanded clinic facilities. Since each of the 43 dental schools now in operation is either state-supported or a nonprofit agency within the meaning of the bill all would be eligible to participate in the program.

The Association therefore recommends that H.R. 8149 be amended as suggested.

Your attention should also be called to the language appearing on page 15 defining a "rehabilitation facility." Here, at line 12, the bill reads: "or (B) all medical or related health services are prescribed by, or are under the general direction of, persons licensed to practice medicine in the state." As I have explained before, the responsibility for the dental health of patients is imposed by law directly upon the dentist. His services cannot be prescribed by the members of another profession. In such cases the physician and the dentist consult with each other with respect to the health problem involved, but neither prescribes what the other shall do or not do. Rehabilitation work should not exclude the dentist on account of such language since there is much for him to do in this general area in the fields of maxillofacial surgery, cleft palate and cleft lip repair, orthodontics, and the like. Since, in some states, there are facilities for this sort of rehabilitation directly under the direction of dentists, and in other states some hospital directors are dentists, it would not seem wise to use language which would naturally exclude this branch of the health professions from participating in the programs envisioned by the bill. The Association would suggest that here, too, a suitable amendment be inserted.

The last bills to be discussed are the so-called "Reinsurance Bills," S. 3114 and H.R. 8356. These bills propose to increase the quantity of health care available in the country by establishing a system of reinsurance under which it is hoped that private insurance carriers will be induced to expand their present areas of interest to new fields. It is conceivable that under this bill it might even be possible to obtain a program of dental health care insurance. However, no one can say for certain at this time.

The problem in this country still remains a matter of providing health care services. Financing of those services is only one aspect of the problem. Others are: a willingness on the part of the individual to plan and budget for at least some of his foreseeable health care costs; the distribution of health service personnel in areas where there is a sufficient demand for their services to permit them to earn a living; expansion of facilities for training health care personnel; better use of auxiliary personnel to expand the quantity of service offered; and continuing programs to educate the public as to good health habits and good personal hygiene. This program attacks the problem only in the area of financing and to an extremely limited extent in that area.

The Association would recommend that the Congress take no action this year on this measure, but rather that additional time be allowed to permit all interested groups to study the proposal in its implications as well as in its explicit provisions, so that an ample opportunity will be provided to make the necessary corrections in the program before it is initiated.

On behalf of the American Dental Association, may I again thank you for this invitation to appear and express its views.

Association views on veterans' home-town care appropriations

Paul E. Jones of Farmville, N. C., a member of the Council on Legislation, appeared before the Senate Committee on Appropriations and presented the views of the Association concerning appropriations for veterans' home-town care. Dr. Jones had previously testified before the House Committee (see THE JOURNAL, May 1954, p. 567). The statement which follows is directed to changes in the bill which were made by the House and to situations which were not discussed in the hearings before the House Committee. He was accompanied by Mr. Howard N. Greenblatt, assistant secretary of the Council.

I am Paul E. Jones, a practicing dentist of Farmville, N. C. I am here today as a member of the Council on Legislation of the American Dental Association to present the views of that organization with respect to H.R. 8583, the Independent Offices Appropriation Act, 1955. With me is Mr. Howard N. Greenblatt of Chicago, assistant secretary of the Council.

As you know, the American Dental Association is the official spokesman for more than 84 per cent of the 83,000 practicing dentists of the country. Consequently, the Association is concerned with all matters which affect the dental health of the public or the practice of dentistry. This bill, because it contains appropriations for dental treatment through the Veterans Administration falls into the class of subjects on which the Association should make known its views.

The budget for fiscal year 1955 (page 157) sets forth a request by the Veterans Administration for $5,810,000 to provide for fee basis outpatient dental care. The President in his budget message (page M 53) recommended this sum contingent upon retention of a legislative rider which had been attached to the fiscal 1954 appropriation act.

This bill now comes before the Senate without that rider, it having been stricken by the House of Representatives on the point of order that it contained substantive legislation. Also missing from the bill is language contained in the budget which earmarked this sum for the use of the fee basis outpatient dental program. This latter clause was removed by Committee action and was not reported to the House.

We wish to raise three points for your consideration: (1) the effect of eliminating the rider; (2) the desirability of earmarking this appropriation and (3) the adequacy of the amount appropriated for this purpose.

The Veterans Administration dental program prior to last year was a source of concern to both Congress and the American Dental Association. The adoption of the rider, plus the issuance by the Veterans Administration of Circular 2, dated January 25, 1954, had the combined effect of eliminating much of that concern. Failure to support the present program either by a rider or by substantive legislation along the same lines may tend to restore the program to the old basis against which both Congress and the Association had a legitimate complaint.

In effect, the rider invalidated the old presumptive rule whereby dental disorders discovered within one year after discharge were presumed to be service-connected and eliminated the presumptive effect of Public Law 791, 81st Congress on the dental disorders of Spanish-American war veterans. It further limited the right of veterans pursuing a course of rehabilitation training under Public Law 16, 78th Congress, to have their dental defects corrected except on proof of actual service-connection. It implied that future appropriation bills would contain language which would eliminate the right of veterans, having a service-connected dental disability less than 10 per cent disabling, to obtain any dental treatment after July 27, 1954, unless they applied for treatment within one year after the date of their discharge.

The rider had no effect on the potential patient load during fiscal 1954 since, under its terms, the entire veteran population can apply for treatment prior to July 27, 1954, and if proof of dental service-connection is shown, such applicants will be entitled to receive treatment. If the rider is not re-enacted, or replaced by substantive legislation, this right will continue indefinitely.

Circular 2, while not entirely dependent on the rider or similar legislation, at least derived support from the existence of the promise implied in the rider to reduce the future potential case load. In effect, Circular 2 permits treatment, when and as required, for dental service-connected disabilities greater than 10 per cent; restricts treatment to a one-time basis for veterans applying therefor who have disabilities of less than 10 per cent; and permits adjunct dental treatment for service-connected disorders of a general medical nature.

Historically, outpatient dental treatment by fee-basis dentists has been authorized for veterans since 1919. The program has undergone many changes in that time but was not of sufficient size to be fiscally significant until the mass exodus of veterans after 1945 quintupled the veteran population. During that pre-World War II incubation period certain unscientific bases for authorizing treatment had crept into the program which allowed not only extensive repeat treatment for subsequently occurring dental problems but also permitted the treatment of nonservice-connected conditions in support of teeth deemed to be service-connected.

Applying this doctrine to the 15 million new veterans of World War II mushroomed the program into a fiscal problem of serious proportions, one which had apparently become unmanageable either by Congress or the Veterans Administration. Enactment of the rider coupled with the issuance of Circular 2 appeared to offer to the veteran the dental treatment to which he was entitled on account of any disability incurred in service and, at the same time, to offer to the taxpayer some relief

from the mounting costs of the program as it formerly existed.

In the years following World War II expenditures under this program reached a maximum of 40 million dollars per annum. This was gradually decreased to 23 million dollars last year, not because the demand for service abated but because the appropriations committees refused to recommend the full sums necessary to meet the claims presented by the veterans under their legal entitlement. Last year, the Association told your committee, "Estimating that the combined backlog and new applications will be 750,000 cases during fiscal year 1954 it is apparent that the anticipated cost of the program in realistic terms will be about 79.5 million dollars."

Elimination of the rider eliminates the basis on which the President and the Veterans Administration constructed and justified the present budget. It will mean that the program potentially will not be a 5 or 10 million dollar charge but that the cost may run as high as 25 or 30 million dollars, assuming that Circular 2 is not repealed and that Congress, in the future, is willing to pay for the program in accordance with the demand.

The Association believes, as Congressman Frelinghuysen stated on the floor of the House in support of the rider, that it is a stopgap measure which should be approved, but that Congress should also consider presently pending legislation to put the program as it exists today on a permanent basis.

It will be noticed that the House abandoned the practice started last year of earmarking funds for the dental outpatient program. Although it is true that the language employed placed a ceiling on the amount available for dental purposes, the Association believes that this is of technical effect only, since the expenditure of funds would normally be limited by the amount justified to the Appropriations Committees during hearings on the bill. Further, if the amount is determined to be inadequate because of earmarking, the Veterans Administration always has the right to request a supplemental appropriation, thus giving the Congress an opportunity to evaluate the request for additional funds. The Association also believes that because of the cost of this program in the past, and the extensive criticism of that cost, earmarking is necessary to identify to the people the true cost of the program from year to year.

In previous years, when dental funds were lumped in a general medical appropriation to be disbursed to the dental division by the chief medical director at his discretion, it frequently happened that funds would be made available to the dental division so close to the end of a fiscal quarter that it was unable to make money available to the field in time to be used before the quarter elapsed. By making known, in the appropriation act, the total amount to be made available, and by specifically earmarking the amount provided, the dental service will be able to plan the use of the funds in an orderly manner with a view to obtaining the maximum amount of dental work for the entitled veteran and the greatest fiscal benefit to the government.

Finally, may I turn my attention to the amount of the appropriation. If the rider is eliminated it is immediately obvious that the 5.81 million dollars contained in the justification will be totally inadequate. It is hardly possible to make an estimate of what the cost will be but it is reasonable to expect that it will not be less than the 23 million dollars provided in fiscal 1954. Therefore, if your Committee decides not to restore the rider, the Association urges that the total asking in this section be increased by 17.19 million dollars, thus earmarking 23 million dollars for outpatient fee basis dental expenditures and increasing the total appropriation in this division from 76.7 million dollars to 94 million dollars as a minimum requirement.

If, on the other hand, your Committee does restore the rider, the Association still believes that 5.8 million dollars is too low to take care of the existing backlog of approved applications plus the cases which will be approved during the next fiscal year. The Association believes that it would be better to provide sufficient funds during this fiscal year to clean up the existing backlog and then to appropriate for future years only the sums necessary to meet the anticipated load which will be derived solely from those persons who are discharged from the Armed Forces during any given fiscal year. In this instance the Association recommends that a minimum of 10 million dollars be earmarked for dental outpatient fee basis treatments during fiscal 1955.

COUNCIL ON DENTAL THERAPEUTICS

Council announces classification of additional products

The classification of products by the Council on Dental Therapeutics has been described in a previous report (J.A.D.A. 40:489 April 1950). The Council's program now provides for classification of products in Group A, Group B, Group C and Group D. Products are reconsidered periodically, and decisions are subject to change at any time that a substantial amount of new evidence becomes available. The files of the Council contain information on many drugs and dental cosmetics, and inquiries are welcome.

GROUP A

Listing of products in Group A means that at the time of their consideration, the items conformed with the provisions for acceptance established by the Council on Dental Therapeutics and adopted by the Board of Trustees and the House of Delegates of the American Dental Association. Items in this group will be listed in *Accepted Dental Remedies* and may use the Seal of Acceptance, unless otherwise provided.

GROUP B

Listing of products in Group B means that there is insufficient evidence to justify their present acceptance, but there is reasonable evidence of their usefulness and safety. These products meet the other qualifications and standards established by the Council on Dental Therapeutics. It is the Council's opinion that Group B products may be promoted for special use and study.

The Council's initial consideration of products which may be eligible for Group B listing is influenced favorably by the knowledge of further investigations then in progress. It is the policy of the Council to reconsider Group B products each year on the basis of new evidence which may be produced in their support. Classification in this category is not ordinarily continued for more than three years.

The following additional product is classified in Group B:

Hydrocortisone Acetate

Saline Suspension of Hydrocortone Acetate 2.5% (Merck & Company): A sterile, saline suspension containing hydrocortisone acetate 25 mg. per cc., for injection into the intra-articular spaces to relieve symptoms associated with diagnosed rheumatoid arthritis or osteoarthritis of the temporomandibular joint. Dosage of 5 to 10 mg. of hydrocortisone acetate (0.2 to 0.4 cc. of this suspension) by intra-articular injection is stated to be adequate. (See Council report on cortisone and hydrocortisone acetate, page 704.)

GROUP C

Listing of products in Group C means that the evidence is so limited or inconclusive that the products cannot be accurately evaluated. It is the Council's opinion that Group C products require further study by qualified investigators.

The following additional product is classified in Group C:

Hydrocortisone Acetate

Dental Ointment of Hydrocortone Acetate 2.5% (Merck & Company): The product consists of hydrocortisone acetate 2.5 per cent, in a nonirritating ointment base. It is suggested for the treatment of "refractory gingival disease." (See report on page 703.)

GROUP D

Listing of products in Group D means that they are unacceptable because of their demonstrated inability to meet the standards outlined in the provisions for acceptance.

Dental Ointment of Hydrocortone Acetate 2.5%-Merck & Co. classified in Group C

As a result of the active promotional campaign for Dental Ointment of Hydrocortone Acetate 2.5%-Merck, the Council on Dental Therapeutics has reviewed the claims for this product, and the following report is designed to provide the profession with information on the current status of this item.

According to Merck & Company, the product consists of hydrocortisone acetate 2.5 per cent, in a nonirritating ointment base. The firm advocates its use by topical application with massage to affected oral tissues two or three times daily, for the treatment of "refractory gingival disease," including acute and chronic gingivitis, desquamative gingivitis and hyperplastic gingivitis. It is suggested further that the drug may be of benefit in leukoplakia, glossitis, aphthous ulcers, burns of small areas of the mucosa, and gingivitis of pregnancy. In acute, chronic, desquamative and hyperplastic gingivitis, use of the product is recommended when conventional therapy has been without effect, and it is advised that predisposing causes of the condition should be eliminated in the course of hydrocortisone treatment.

The Council has reviewed case reports from the records of several private practitioners and of certain institutional clinics, which were provided by the firm in support of its claims for usefulness of the product. The criteria by which the investigators evaluated changes in the progress of the conditions studied were not described adequately for the purpose of objective assessment of these records. Treatment with the drug was on an empiric basis, and often it was not clear whether the described results were due to the use of the drug or to the usual periodontal treatment, such as scaling, which was employed in many cases.

Because of the difficulties involved in evaluating agents in the treatment of periodontal diseases, the Council believes the firm should obtain evidence from controlled studies. For this purpose, one group of selected patients might be treated with hydrocortisone acetate ointment, under specified conditions, and another group treated with a placebo (consisting of the same ointment base without hydrocortisone acetate) under the same conditions. The firm has not indicated that any such basic investigation has been performed or that such a one is contemplated.

The Council assumes that drugs of the cortisone type may be of value in the treatment of certain inflammatory conditions. However, the complicated etiologic factors in inflammation of the gingivae are such that drugs which are effective in inflammation of other tissues frequently fail to produce beneficial results in periodontal disease. The Council considers the presently available evidence insufficient to support the claims made for the usefulness of Hydrocortone Acetate Ointment 2.5% in the treatment of the oral conditions previously cited. It is the Council's belief that the promotion of the product to the profession is premature.

The Council therefore has voted to classify Dental Ointment of Hydrocortone Acetate 2.5%-Merck & Company in Group C. In accordance with the policy of the Council, the product may be reviewed with a view to reclassification whenever a substantial amount of new evidence becomes available.

Report on cortisone and hydrocortisone acetate

Cortisone and related compounds, including hydrocortisone acetate, have been employed effectively in medicine to alleviate the acute symptoms and manifestations of rheumatoid arthritis and osteoarthritis. Neither cortisone nor its analogues can effect a cure of the arthritis, but their action frequently abolishes pain and permits greater movement of arthritic joints, with ensuing comfort and relief to the patient. Unfortunately, their effect is transient, and the disease usually progresses even in the absence of distressing symptoms. Cortisone may be administered for the comfort of the patient, but its prolonged use may, in high dosage, produce serious adverse effects including disturbances of electrolyte balance, endocrine function, and personality. By suppressing the signs and symptoms of inflammation, the drug may mask or intensify the progress of infection. In some instances fatal infections have been discovered only at autopsy.[1]

Although satisfactory results in arthritis have been obtained by systemic administration, the method of injection into the intra-articular spaces of the affected joints is widely practiced because fewer side effects are observed during treatment by the latter procedure.

Hydrocortisone acetate produces the same results as the parent drug, when injected into the joint, but it appears to provide more prolonged and profound effects, and its use is said to be accompanied by less local irritation. Pain and stiffness are usually reduced within 24 hours, and the effects may persist for 3 or 4 days, or longer.

Intra-articular injection may be of value when the joint is inflamed, but the procedure rarely is beneficial when ankylosis is present.

For the treatment of the temporomandibular joint involved with arthritis, the injection of 5 to 10 mg. of the drug may relieve pain and improve mandibular movement. The technic of injection requires considerable skill, however, and it should be attempted only by individuals who are especially familiar with the anatomic difficulties that may be encountered.

The use of the drug in this manner for treating arthralgia of ill-defined etiology is not advocated on the basis of evidence presently available. It is important, therefore, that a diagnosis of rheumatoid arthritis or osteoarthritis be established before treatment is instituted.

1. Beckman, Harry. Pharmacology in clinical practice. Philadelphia, W. B. Saunders Co., 1952.

BUREAU OF LIBRARY AND INDEXING SERVICE

The American Dental Association Film Library

The following films have been added to the American Dental Association Film Library and are now available at a nominal rental fee of $2.50 to dental societies, study clubs, dental schools, hospital dental staffs, and armed services dental personnel. Reviews of "School Health in Action" and "Hydrostatic Impressions" will appear in a subsequent issue of THE JOURNAL. The films, "School Health in Action" and "Operative Hypnodontics," may be used by professional and nonprofessional groups. How and under what circumstances the latter film should be shown, however, is discussed in the review appearing in this article.

FILMS RECEIVED

School Health in Action • 16 mm., color, sound, 915 feet, 25 min. Produced in 1953 for the Oklahoma State Department of Health by Sam Orleans and Associates, Inc. Procurable on loan ($2.50) from the American Dental Association Film Library, 222 E. Superior St., Chicago 11, and on loan or purchase ($185.00 plus $4.50 for reel and can) from Sam Orleans and Associates, Inc., 211 W. Duberland Ave., Knoxville, Tenn.

This film shows how community groups in Waytoka, a typical city in Oklahoma, recognized their health problems and how they cooperated in working out a plan to solve them. (Suitable for PTA's, community groups and health departments.)

Hydrostatic Impressions • 16 mm., 840 feet, color, silent, 30 min. Produced in 1947 by Ernest R. Granger, D.D.S. Procurable on loan ($2.50) from the American Dental Association Film Library, 222 E. Superior St., Chicago 11.

The technics of impression taking which are demonstrated in this film are based on the principles referred to as mucostatics. The principles underlying these technics are opposed to those on which the conventional methods of taking impressions are based. (Suitable for dental students, general practitioners, hospital dental staffs, Armed Forces, and prosthodontists.)

FILM REVIEW

Operative Hypnodontics • 16 mm., black and white, sound, 800 ft., 18 min. Produced in 1953 by Aaron A. Moss, D.D.S. Photography by Community Films, Newark, N. J. Procurable on rental ($2.50) from the American Dental Association Film Library, 222 E. Superior St., Chicago 11, and by purchase from the producer at 20 Morristown Road, Bernardsville, N. J.

The purpose of this film as stated by its producer is to teach a standardized technic of hypnosis in dentistry. The film opens with a referral to books on this subject applicable to medicine and to dentistry. An outline of the steps involved in the application of hypnosis to operative dentistry is noted and discussed. These steps are: mind set, preliminary testing, induction, deepening, operative work, posthypnotic suggestion, and awakening. These steps are then demonstrated on five patients who were selected on the basis of previous conditioning and susceptibility.

This film, which is well organized, is suitable for informational rather than for teaching purposes. Since the subject is controversial, dental societies and dental study clubs may find it provocative program material. Although it was produced primarily for showing before professional groups, it may be shown before nonprofessional adult audiences if the dentist presenting the film practices the technics illustrated and can demonstrate them to the audience. Extreme caution is suggested before the film is shown to nonprofessional audiences since the nature of the topic makes it "sensational" material for newspaper publicity.

For supplementary background material on this subject, the film user can refer to books and package libraries available from the Bureau of Library and Indexing Service.

BUREAU OF ECONOMIC RESEARCH AND STATISTICS

The 1953 survey of dental practice
VI. Number of patients

The most striking aspect of the survey findings on the number of patients treated per dentist is the great variability (Table 35). The mean number of patients reported was 1,012 and the median 724; however, the variation was so great that these two measures of central tendency cannot be considered to describe a "typical" dentist. When dentists are grouped by hundreds of patients treated, as in Table 35, more dentists fall into the 500 to 599 patients group than any other, followed by the 400 to 499 group. There is no cluster of dentists in any one group.

The distribution of dentists according to number of patient visits is shown in Table 36. The mean number of patient visits was 2,872. Thus, the mean number of visits per patient during the year was 2.8.

Approximately half of the independent dentists participating in the survey did not answer the questions on number of patients and number of patient visits. Among those who did answer many gave rough estimates rather than exact figures. Dentists who have readily available records on the number of different patients seen each year are in a minority. Consequently the statistics on number of patients are less reliable than are most of the other results of the survey.

Table 37 and Figure 4 present the average number of patients according to region. The mean number of patients in the Southeast region was about twice the figure for the Middle East. On first thought this may seem unreasonable. When it is considered, however, that the population per dentist in the Southeast is well over twice what it is in the Middle East, it becomes obvious that each dentist in the Southeast is required to treat more patients. It can be estimated from figures on the mean number of patients, number of dentists and population of these regions, that the percentage of the population seeing the dentist during the year was lowest in the Southwest and Southeast regions, despite the fact that dentists in those areas reported the greatest average number of patients. The highest percentage of the population obtaining dental care was in the Far West and Northwest. Other regions occupied intermediate positions.

The mean number of patients reported by dentists in New York (512 patients) and Chicago (593 patients) was well below the national mean (1,012 patients). The number of answers to this question from dentists in other large cities was insufficient to allow presentation of averages. The variation in mean number of patients according to city size categories did not present a clear pattern. The largest number of patients was reported by dentists in cities of 2,500 to 25,000 population.

Although the income of dentists was highest in the age group 40 to 44, the highest average number of patients was reported by dentists in their fifties (Table 38). Comparison of other tables correlating income and number of patients with a common third factor reveals that the correlation between income and number of patients is not perfect.

The mean number of patients reported by specialists as a group was almost the

The first five articles in this series appeared in The Journal for December 1953 and January, February, April and May 1954.

same as that of general practitioners (Table 39). That specialists cannot be considered a homogeneous group with respect to number of patients can be seen by comparing the average number of patients reported by oral surgeons and orthodontists. Oral surgeons reported treating about ten times as many patients during the year as did orthodontists. Unfortunately, too few dentists in other specialties answered this question to provide reliable statistics.

The mean number of patients according to number of auxiliaries and number of chairs is shown in Tables 40 and 41. A peculiarity of the relationship of number of patients to number of employees is that those dentists reporting .1 to .4 employees (see definition in footnote of Table 40) averaged fewer patients than did those dentists without employees. This is probably a statistical artifact. It seems likely that a large proportion of the dentists reporting .1 to .4 employees themselves worked less than a full year, which would account for the lower number of patients.

There is, of course, a high positive correlation between number of employees and number of chairs. The increase in number of patients with increase in number of chairs shown in Table 41 is probably attributable mainly to an increase in number of employees.

The mean number of patients reported by members of the American Dental Association was 1,027 compared to 715 for nonmembers. Independent dentists in solo practice averaged 997 patients, compared to 1,017 for those who shared costs of offices or personnel, and 1,373 for dentists in partnership with other dentists. Dentists employed by other dentists averaged 1,091 patients.

The mean number of patients reported by dentists in the 1950 Survey of the Dental Profession was 933, which led to an estimate that 40 per cent of the population saw the dentist during the course of a year. In arriving at this esti-

Table 35 • Percentage distribution of independent dentists by number of patients in 1952

No. of patients	Per cent of dentists	Cumulative per cent
–99	1.5	1.5
100–199	5.5	7.0
200–299	8.6	15.6
300–399	7.0	22.6
400–499	8.8	31.4
500–599	9.4	40.8
600–699	6.1	46.9
700–799	5.2	52.1
800–899	6.0	58.1
900–999	4.1	62.2
1,000–1,099	7.0	69.2
1,100–1,199	1.7	70.9
1,200–1,299	4.7	75.6
1,300–1,399	1.0	76.6
1,400–1,499	1.5	78.1
1,500–1,599	5.1	83.2
1,600–1,999	3.6	86.8
2,000–2,399	4.8	91.6
2,400–2,799	2.8	94.4
2,800–3,199	2.4	96.8
3,200–	3.2	100.0

Table 36 • Percentage distribution of independent dentists by number of patient visits during 1952

No. of patient visits	Per cent of dentists	Cumulative per cent
–499	2.0	2.0
500–999	5.0	7.0
1,000–1,499	10.2	17.2
1,500–1,999	13.3	30.5
2,000–2,499	16.5	47.0
2,500–2,999	14.0	61.0
3,000–3,499	11.8	72.8
3,500–3,999	8.6	81.4
4,000–4,499	5.5	86.9
4,500–4,999	4.4	91.3
5,000–5,499	3.3	94.6
5,500–5,999	1.1	95.7
6,000–6,499	1.1	96.8
6,500–6,999	0.6	97.4
7,000–	2.6	100.0

Table 37 • Average number of patients of independent dentists in 1952, by region

Region	Mean no. of patients	Median no. of patients
New England	858	655
Middle East	757	497
Southeast	1,530	1,098
Southwest	1,234	955
Central	951	747
Northwest	1,198	895
Far West	1,055	797
United States	1,012	724

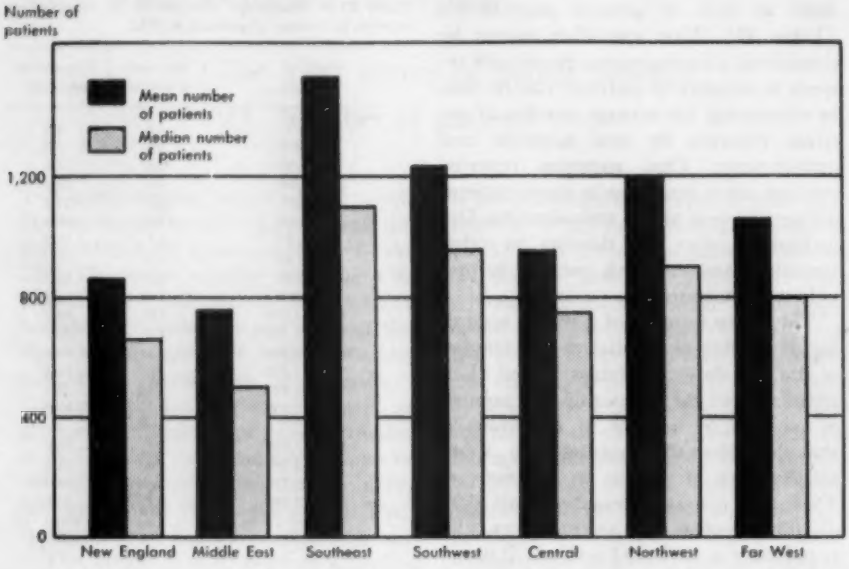


Fig. 4 • Average number of patients of independent dentists in 1952, by region

mate a rather arbitrary allowance was made for the probable number of people who saw more than one dentist during the year and for a suspected upward bias in the survey statistics. Applying the same procedure to the statistics of the current survey, it is estimated that 42 per cent of the population saw the dentist during 1952.

An attempt was made to determine what proportion of dentists felt they were too busy, not busy enough, or experienced a balance between demand and their ability to meet it, by asking the questions shown in Tables 42 and 43. That these questions discriminated effectively may be seen in Table 43. The proportion of dentists who reported having about the right number of patients varied little from region to region. There was considerable regional variation, however, in the pro-

Table 38 • Average number of patients of independent dentists in 1952, by age of dentist

Age of dentist	Mean	Median
25–29	753	508
30–39	1,016	702
40–49	1,031	801
50–59	1,129	805
60–69	943	745
70–	565	455
All ages	1,012	724

Table 39 • Average number of patients of independent dentists in 1952, by type of practice

Type of practice	Mean no. of patients	Median no. of patients
General practitioner	1,011	754
Specialist	1,026	453
Oral surgeon	2,858	2,375
Orthodontist	289	246
Pedodontist	*	*
Periodontist	*	*
Prosthodontist	*	*
All independent dentists	1,012	724

*Too few replies for reliable statistics.

Table 40 • Mean number of patients of independent dentists in 1952, by number of auxiliary employees*

No. of employees†	Mean no. of patients
0	654
.1– .4	580
.5–1.4	1,006
1.5–2.4	1,356
2.5–3.4	2,088
3.5 and more	2,419
All independent dentists	1,012

*Dentists who employed dentists were excluded from this table.

†Part-time employees and employees who did not work the full year were counted as fractions.

Table 41 • Mean number of patients of independent dentists in 1952, by number of dental chairs used

No. of chairs	Mean no. of patients
1	702
2	1,082
3	1,574
4 or more	2,273
All independent dentists	1,012

portion of dentists reporting too few or too many patients.

More than one fourth (26.3 per cent) of the dentists of the Middle East indicated they did not have as many patients during 1952 as they would have liked, and this region also had the lowest proportion of dentists (10.5 per cent) who reported they could not accommodate all persons who requested appointments. The smallest percentages of dentists who said they were not busy enough in 1952 were in the Northwest (7.9 per cent) and Far West (8.8 per cent).

Those dentists who said they did not have as many patients as they wanted in 1952 were asked to indicate how many additional patients they would have liked (Table 44). The mean of the replies was 262 and the median 200.

"Training in a school for dental assistants" was favored by 44.3 per cent of the respondents as the best background for a dental assistant, followed by "experience as an assistant in a dental office" (32.5 per cent) and "clerical training" (12.6 per cent) (see Table 45). This question was asked as follows: "Suppose you were hiring a dental assistant, and there were prospects available with the following backgrounds. Which would you prefer?"

Table 42 • Percentage distribution of independent dentists according to description of practice in 1952, by region

Description of practice	New England	Middle East	South-east	South-west	Central	North-west	Far West	United States
Because of the length of your appointment list, some persons who contacted you for dental care actually obtained this care from another dentist.	18.5	10.5	30.7	25.6	21.2	25.4	27.5	20.9
You provided dental care for all who requested appointments, but you felt more rushed and worked more hours than you would have liked.	15.9	19.1	17.1	17.7	20.4	22.1	18.4	18.8
There was a good balance between the number of persons who contacted you for dental care and your ability to provide this care.	45.0	44.1	40.8	46.3	45.6	44.6	45.3	44.9
You did not have as many patients as you would have liked.	20.6	26.3	11.4	10.4	12.8	7.9	8.8	15.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 43 • Average number of patients of independent dentists in 1952 according to description of practice

Description of practice	Mean no. of patients	Median no. of patients
Because of the length of your appointment list, some persons who contacted you for dental care actually obtained this care from another dentist.	1,370	1,025
You provided dental care for all who requested appointments, but you felt more rushed and worked more hours than you would have liked.	1,249	1,000
There was a good balance between the number of persons who contacted you for dental care and your ability to provide this care.	932	650
You did not have as many patients as you would have liked.	457	350
All independent dentists.	1,012	724

Table 44 • Percentage distribution of independent dentists who did not have a sufficient number of patients in 1952, by number of additional patients wanted

No. of additional patients wanted	Per cent of dentists
– 99	21.6
100–199	27.6
200–299	17.6
300–399	11.6
400–499	4.9
500–599	5.3
600–699	1.9
700–799	2.1
800–899	0.7
900–999	4.6
1,000–	2.1
Total	100.0

Table 45 • Percentage distribution of independent dentists according to dentist's preference with regard to training or background of dental assistant

Background preferred	Per cent of dentists
Training in a school for dental assistants	44.3
Experience as an assistant in a dental office	32.5
Clerical training (typing, bookkeeping, etc.)	12.6
Other	10.6
Total	100.0

Table 46 • Percentage distribution of independent dentists by length of course recommended in school for dental assistants

Length of course recommended	Per cent of dentists
One academic year (9 months), full-time (or equivalent)	53.3
One-half academic year (4½ months), full-time (or equivalent)	21.7
One-third academic year (3 months), full-time (or equivalent)	13.2
Three or four weeks, full-time (or equivalent)	5.2
Other	6.6
Total	100.0

A second question relating to dental assistants was as follows: "If you believe that training in a school for dental assistants is desirable, how long a course do you recommend?" As shown in Table 46, more than half (53.3 per cent) of the respondents checked "one academic year." Only a small proportion (5.2 per cent) of the dentists thought a short course of three or four weeks was sufficient to train the dental assistant.

A final article summarizing the results of this survey will appear in a subsequent issue of THE JOURNAL.

B. Duane Moen, Director

Survey of dental postpayment plans

Questionnaires designed to elicit information on society-sponsored dental postpayment plans were sent to all constituent (state) and component (district) societies in 1953. By late in the year, after follow-up letters had been sent to societies that had not returned questionnaires, 42 constituents and 299 components had replied, out of a total of 54 constituent and 450 component societies.

Seven constituents and 42 components reported sponsoring postpayment plans. Establishment of plans was under consideration in one state and five district societies. It is doubtful that more than three or four plans were in existence in 1953 in constituent and component societies that did not return questionnaires. It is known, however, that plans are sponsored by several local (noncomponent) societies, which were not included in this survey.

Of the 49 plans reported, the oldest was established in 1935. Only seven were established between 1936 and 1948. The movement then began to make headway. Three plans were established in 1949, four in 1950, and 13 in each of the years 1951 and 1952. Seven were reported to have been established in 1953 before the questionnaires were returned.

To the question of whether a credit reporting agency was used in determining whether the patient should be granted a loan, 32 societies replied "yes," 3 replied "no," and 13 stated that the bank was responsible for checking credit.

In only two plans did the dentist have final responsibility for deciding whether the patient was eligible for a loan. In the other 47 societies the bank held this responsibility. In only two societies, however, did the patient have to go to the bank to complete the transaction qualifying him for a loan. Only one society indicated that a co-signer was required on the patient's note, and no society answered "yes" to the question of whether the patient was required to furnish collateral for his loan.

To the question, "By what means are patients informed of the availability of the postpayment plan?" 41 societies mentioned only the dentist's office as the patient's source of information on the plan, the information being provided by the dentist himself, auxiliary personnel or a small sign in the office. Other replies included "the bank and the dentist"; "literature furnished by the bank"; "TV spot announcements," and "newspaper and radio advertisements."

Twenty-six societies indicated a definite course of instruction was conducted for dentists who participated in the plan, and 21 societies said no such course was provided. Forty-seven societies stated their plans were limited to members of the American Dental Association, and the other two societies sponsoring plans failed to answer this question.

As shown in Table 1, the most common rate of interest charged was 6 per cent, although a sizable number of societies reported 5, 7 and 8 per cent. It is believed that under most if not all plans this interest is paid on the face amount of the note for the entire period of payment. The bank's charge actually is a "service charge" rather than interest in the usual sense of the term. The cost to the bank of servicing a small loan is high in proportion to the amount of the loan.

In five societies, the interest on the note included life insurance on the patient in the amount of the note (Table 2). Nearly half of the societies that answered the question on charges for life insurance indicated no such charges were made. The most common charge was 1 per cent of the amount of the note.

Under most postpayment plans a certain percentage of the dental bill is paid into a reserve fund held at the bank to

offset losses owing to nonpayment. Table 3 shows that 5 per cent is the most common amount withheld from the dentist and paid into the reserve fund, with 4 per cent the next most common amount.

Questionnaires from 39 societies stated the amount withheld for the reserve fund was proving to be sufficient to offset losses. The remaining 10 either stated they did not know or gave no answer whatever to the question. Only one society stated the dentist suffered any loss when the patient failed to pay the full amount of the note.

The information supplied relative to number of accounts and amounts financed was incomplete and lacked uniformity. Only seven societies submitted statistics covering both the number of accounts financed and the total amount financed (Table 4). The average loan reported by these seven societies was $231. Averages reported by the seven societies did not vary greatly. In view of the fact that not many dental bills are much in excess of this figure, it appears that there were few small dental bills financed.

A total of 26 societies submitted statistics on the amount financed over a specified period of time. By converting each figure to a yearly basis, it was estimated that the 26 societies financed about $6,370,000 in dental bills per year, with a mean of about $245,000 per society per year. The mean was pulled up, however, by a small number of unusually large plans, and the median was only $49,500.

Table 1 • Distribution of dental societies according to interest paid by patient on the amount of his note

Interest (per cent)	No. of societies
5	7
6	27
7	6
8	6
No answer	3
Total	49

Table 2 • Distribution of dental societies according to life insurance charges

Life insurance charges (per cent)*	No. of societies
Included with interest on loan	5
0	20
0.075	1
0.4	1
0.48	1
0.5	2
1.0	11
Varies	1
Optional	1
No answer	6
Total	49

*Per cent of face amount of note.

Table 3 • Distribution of dental societies according to per cent of dental bill paid into reserve fund to offset losses owing to nonpayment

Per cent	No. of societies
0	3
2	1
2.5	1
3	2
4	9
5	28
6	1
8	1
0-15	1
No answer	2
Total	49

Table 4 • Statistics on postpayment plans reported by seven dental societies

Length of period covered	Total amount financed	No. of accounts	Average loan
19½ months	$2,710,021	12,448	$218
32 months	5,970,657	24,828	240
1 year	261,549	1,109	236
1 year	9,680	47	206
6½ years	149,698	956	157
1 year	36,465	179	204
14 months	26,213	161	163
Total	$9,164,283	39,728	$231

Six societies reported the financed amounts outstanding at the time of the survey. The total number of notes outstanding was 11,172, and the average unpaid amount was $140. Ten societies reported the amount deposited in the reserve. The mean amount was $18,173 and the median $4,295.

Twenty-seven societies reported that a total of 4,079 dentists had participated in the plans during 1952. These figures include nine societies that supplied figures for only part of the year. The range in number of participants was from 12 to 1,457. The mean was 151 and the median was 50 participants.

Respondents were asked to "describe briefly the composition and functions of the controlling commission or governing body of the plans." A total of 30 societies stated a committee of the society was appointed to control the plan. Seventeen of these societies gave the number of committee members, which ranged from three to nine. Four societies stated the plan was "handled by the bank and officers of the society" and six societies reported the bank had complete charge of the plan.

The principal duties of committees were (1) to determine policy and procedure, (2) to oversee operation of the plan in cooperation with the bank, (3) to arbitrate differences between the dentist and the bank, (4) to control publicity for the plan, and (5) to render periodical reports to the society.

Sponsorship of postpayment plans was reported by the following constituent dental societies: California, District of Columbia, Nevada, Oklahoma, Oregon, Rhode Island and Wisconsin. States in which components reported plans, and the number of plans reported, were as follows: Alabama (1); Southern California (5); Georgia (1); Indiana (1); Kentucky (1); Maryland (1); Michigan (7); Missouri (2); Montana (1); New Mexico (1); New York (3); Ohio (1); Pennsylvania (2); Tennessee (4); Texas (5); Utah (3); Virginia (2), and Washington (1).

B. Duane Moen, Director

COUNCIL ON DENTAL RESEARCH

List of certified dental materials

We have been advised by the manufacturers of the following materials that they wish to withdraw these products from the List of Certified Dental Materials.

CERTIFIED INLAY CASTING GOLD ALLOYS (A.D.A. SPECIFICATION NO. 5)

Alloy	*Type*	*Manufacturer or distributor*
Chilcast 1M	B, Medium	Vernon-Benshoff Co.
Stern No. 3290	B, Medium	I. Stern & Co., Inc.
Stern No. 3465	C, Hard	I. Stern & Co., Inc.

CERTIFIED DENTURE RESINS (A.D.A. SPECIFICATION NO. 12)

Material	*Form*	*Manufacturer or distributor*
Justi-Tone	Pink, powder-liquid	H. D. Justi & Son, Inc.
Lucitone	Clear, plastic cake	The L. D. Caulk Co.

JUNE 1954

LON W. MORREY, D.D.S., EDITOR
VOLUME 48 • NUMBER 6
Published by the American Dental Association
222 E. Superior Street • Chicago 11, Illinois

THE Journal OF THE AMERICAN DENTAL ASSOCIATION

Editorials

The evaluation of scientific findings by those untrained in science

Last year a bill to prohibit the fluoridation of community drinking water was introduced in the House of Representatives of the Congress. Last month the Interstate and Foreign Commerce Committee suddenly announced that it would hold hearings on the bill. Last week, May 25-27, such hearings were held.

Introduced by Congressman Roy W. Wier of Minnesota, the bill (H.R. 2341), in one hundred and seven words and one paragraph, purports to protect the public from the presumed dangers of fluoridated drinking water. The wording of the bill appears on page 722 of this issue.

Most legislative authorities agree that the bill in its present form is unconstitutional and infringes on state rights. Jurisdiction over public water supplies rests with the state and local governing bodies. Federal regulations pertaining to drinking water standards are limited to water used by interstate carriers, a point of little or no relevance to the question of fluoridation of a local water supply for the betterment of dental health.

The dental profession is concerned that a committee of the House of Representatives should at this time reinject into the political arena a nonpolitical issue which already has been decided by more than forty years of extensive scientific research. The profession also is concerned that the opponents of fluoridation use the hearings as another sounding board for their often repeated but never substantiated charges that fluoridation is harmful. Because of this concern the Association welcomes the opportunity of presenting once again the mass of evidence favoring fluoridation—

evidence which has been spread on the pages of scientific, professional and popular publications.

Fluoridation is a technical process. Certain basic knowledge of epidemiology, chemistry and biology is essential for a complete understanding of its practicability as a preventive of dental caries. Calm evaluation of its value cannot be made in an atmosphere of fear and demagoguery.

Inasmuch as Congressional leaders have deemed it expedient to attempt to solve this intricacy of science, it is recommended that due consideration be given to the findings of the National Research Council.[1] (See page 722 of this issue.)

Twice within the past three years the National Research Council thoroughly investigated the relationship of fluorine to dental health. The first study was made by the Ad Hoc Committee[2] on Fluoridation of Water Supplies of the Division of Medical Sciences. The second was recently reported by the Committee on Dental Health of the Food and Nutrition Board.[3] Even more recently the St. Louis Medical Society[4] published a report of its investigations which refutes many of the wild allegations that fluoridation affects adversely the health of the people. Reports such as these, representing many months' work by highly qualified scientists, should be given the most careful thought and consideration by those in the executive and legislative branch of government. Certainly these scientific groups would not compromise for a moment on a proposition scientifically unsound or dangerous to the health of the people.

In any event it does not require the intelligence of an Einstein to recognize that the results of research are not determined in congressional halls but in the laboratories and field studies of the scientist. Let Congress attempt to answer political questions. The National Research Council or other qualified scientific bodies can better resolve those of science.

1. The National Academy of Sciences and the National Research Council. Science 234:108 Sept. 3, 1948.

2. Report of the Ad Hoc Committee on Fluoridation of Water Supplies. Washington, D. C., National Research Council, Division of Medical Sciences, Publication 214, 1952.

3. The problem of providing optimum fluoride intake for prevention of dental caries. A report of the Food and Nutrition Board, National Academy of Sciences. Washington, D. C., National Research Council, Publication 294, 1953.

4. Water fluoridation, report of the committee of the St. Louis Medical Society Summary, Missouri Med. 51:124 Feb. 1954.

Full knowledge of occlusion essential to the practice of good dentistry

Specialization in dental and medical practice has been criticized from time to time, even though in some fields specialization is essential in order to produce the best service for the patient. The primary danger in specialization exists not in limiting one's practice but in limiting one's concept of fundamental problems. This type of specialization, however, is not limited to the dental specialties; it exists in general practice as well. One important field in which there is difference of opinion among dentists is the subject of occlusion, to which the greater part of the present number of THE JOURNAL is devoted.

So much confusion surrounds the term occlusion that as Sears[1] states "a review of the literature reveals that some writers do not even distinguish between 'occlusion,'

'articulation' and 'relation.' " This confusion in terminology carries over into practice. All too often the dentist, when treating a carious cavity, makes the mistake of accepting the existing occlusal and proximal relations as guides to the external contour of the restoration. More often than not these are unreliable guides, and the restoration, regardless of its mechanical perfection, fails to restore normal function. Likewise in orthodontics the mistake is sometimes made by both the operator and the patient of evaluating the results of the treatment solely by the interdigitation of the teeth as observed on a set of casts. Many treated orthodontic cases may exhibit excellent anatomical occlusion but at the same time may result in abnormal function of the temporomandibular joints. The same problem pertains to periodontics. Not only must the periodontist adjust the occlusal surfaces of the teeth so as to apportion the occlusal load to the ability of the investing tissues to withstand the pressures, but he must make the necessary alterations in cusp form so as to adjust the articulation to the individual jaw movements of the patient. In prosthodontics the benefits of balanced occlusion are fully recognized, yet wide disagreement continues to exist as to the manner in which such occlusion can best be obtained.

One reason why there is such wide difference of opinion regarding the method of treatment of an abnormally functioning dentition is that too often too many dentists think of occlusion solely in the static or anatomical sense and ignore the more important physiological or functional aspect involving the neuromuscular mechanism.

If the problems of occlusion are to be understood fully and treated properly, the approach must be in accord with the basic principles of neuromuscular physiology and physiology of the temporomandibular joints. The only approach to a workable understanding of occlusion is to know the anatomy, growth and function of the stomatognathic system. It is hoped that the seven basic articles compiled and presented in this issue of THE JOURNAL will make a major contribution to the dentist's knowledge of the subject so that he may apply that knowledge in the best interest of the patient.

1. Sears, Victor H. Occlusion: the common meeting ground in dentistry. New York J. Den. 20:145 April 1950.

Cultivating student membership through the state and local society

Somewhat over 3,000 new dentists will enter the profession on graduation this month. Eighty per cent of these young dentists within a year's time, it may be predicted, will become members of the American Dental Association. Although this fact is a notable achievement for present-day organized dentistry and continues a very creditable record for dental graduates, nevertheless it raises a question as to why the remaining twenty per cent do not choose to assume the responsibilities and enjoy the privileges of their professional brothers.

Participation in the duties and activities of a professional society is not unfamiliar to the newly graduated dentist. Student membership in the American Dental Association with nominal dues is open to all undergraduates, and nearly eighty per cent of the students hold such membership. Whether the nonmember students represent

on the whole the same portion of the graduating class as fail to avail themselves of the opportunity of Association membership after graduation, it is impossible to say, but it seems altogether likely that a one hundred per cent enrollment in the student membership would result in a more nearly total enrollment of young dentists in the Association.

At the conference of state dental secretaries at the Central Office of the Association last November, a member of the senior class of one of the country's dental schools presented "A Dental Student's Views on Student Membership in the Association," which not only described the useful services that such an organization may, and in some instances does, perform for the undergraduate dental student but made clear that the success of such an organization as a means of initiating the student into society activities beyond the walls of the school is clearly the responsibility of the state and local society. He pointed out that almost the only respect in which the American Dental Association is known to the student member is through the payment of his dues and his receipt of THE JOURNAL. He contended also that the constituent and component societies, through which the young dentist must enter into the national association, make too little effort to help bridge the gap from student to professional membership which the student membership was designed to accomplish. The speaker outlined six respects in which the state and local societies might help to give students a feeling of professional participation in their undergraduate days. Briefly, these were as follows:

1. An A.D.A. day in the schools might be established, at which the freshmen would be welcomed and a prominent man in the district or state society would address the group.
2. Local societies might offer prizes for papers and clinics presented by the student members at their school meetings.
3. Prize-winning clinics and papers might be presented at meetings of the state society.
4. Representatives of the state society might address the student meetings on such subjects as practice administration, malpractice insurance, health and accident policies, and other benefits to be derived from society membership.
5. Representatives of the student membership groups might be invited to attend local society meetings.
6. A service might be set up by the local and state societies to advise student members with regard to the advantages of various locations for practice.

It would appear that state and local dental societies have the opportunity, as yet not always accepted, to further the membership growth of the Association and that this matter should have their attention for their own and the new dentists' advantage.

PREVIEW OF NINETY-FIFTH

95TH ANNUAL SESSION AMERICAN DENTAL ASSOCIATION MIAMI, FLORIDA NOVEMBER EIGHTH TO ELEVENTH 1954

Monday afternoon
November 8

PANEL DISCUSSION:
"Elastic impression materials"

by four nationally known authorities

Tuesday afternoon
November 9

PANEL DISCUSSION:
"Newer devices for cutting tooth structure"

by four outstanding scientists

Tuesday morning
November 9

PANEL DISCUSSION:
"Effects of carbohydrates on the teeth"

presented by four eminent researchers

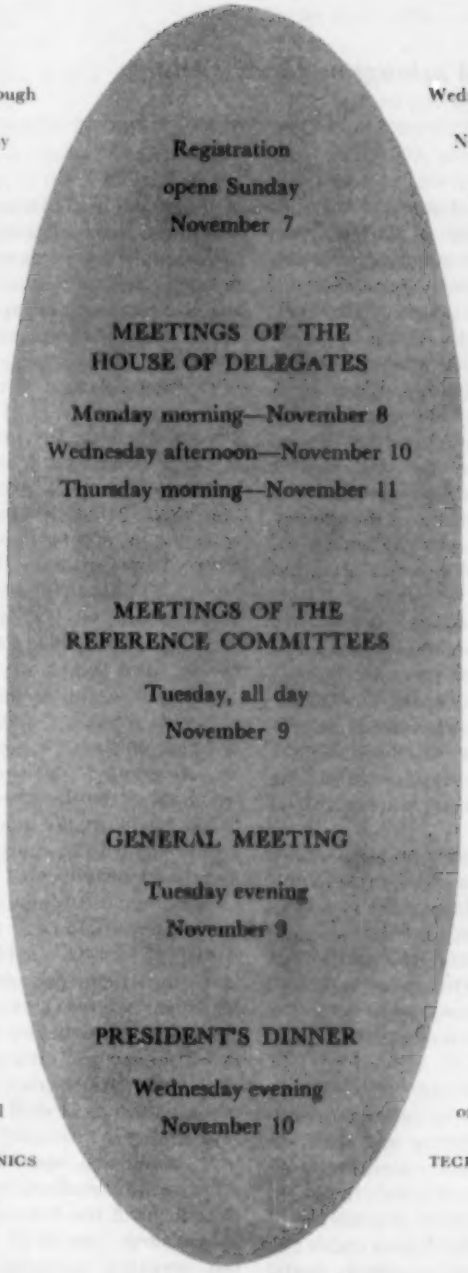
Wednesday afternoon
November 10

PANEL DISCUSSION:
"Radiation hazards in the dental office"

presented by four well-known authorities

MAKE YOUR RESERVATIONS NOW

ANNUAL SESSION



Monday through Wednesday
November 8-10

SCIENTIFIC PAPERS on practical and informative subjects

Monday morning
November 8
Wednesday afternoon
November 10
Thursday morning
November 11

Two hundred and twenty-five practical TABLE CLINICS

Registration opens Sunday November 7

MEETINGS OF THE HOUSE OF DELEGATES

Monday morning—November 8
Wednesday afternoon—November 10
Thursday morning—November 11

MEETINGS OF THE REFERENCE COMMITTEES

Tuesday, all day
November 9

GENERAL MEETING

Tuesday evening
November 9

PRESIDENT'S DINNER

Wednesday evening
November 10

Wednesday morning
November 10
and
Thursday morning
November 11

PROJECTED CLINICS on pertinent dental subjects

Monday through Thursday
November 8-11

Thirty-five MOTION PICTURES

fifty SCIENTIFIC EXHIBITS

one hundred and fifty TECHNICAL EXHIBITS

APPLICATION FORM ON PAGE A-29

Washington News Letter

After many months of study of the subject, the Department of Defense has worked out a plan to standardize health services for servicemen's dependents and is asking Congress to adopt it. However, both the Senate and the House are moving slowly on this bill, pending determination of the proposed program's costs. A further cause of delay is the feeling held by many Congress members that no action should be taken until the Hoover Commission makes its final report in 1955 on administrative reforms in the government's executive branch, including the over-all medical and hospital establishment.

The recently introduced dependents' care bill authorizes treatment of eligible dependents by private practitioners only when military facilities are unavailable or lacking in accommodations. Provisions are made for Treasury reimbursement of nongovernmental agencies furnishing services, with the patient bearing a share of the cost.

Government provision for dependents' dental care is authorized outside continental limits of the United States and in "remote areas" within the country "where adequate civilian dental facilities are not available." Otherwise, it is limited to emergency treatment or as "a necessary adjunct to medical or surgical treatment."

"Emergency dental care," the bill continues, "is defined as the care required to relieve pain and suffering and shall not include any permanent restorative work or dental prosthesis. Dental treatment which may be provided dependents of members of the Armed Forces under this section will be obtained in military dental facilities and will depend upon the availability of space, facilities and capabilities of the dental staff. Dependents of members of the Armed Forces are not authorized dental care at government expense through civilian dental sources, except as a necessary adjunct to inpatient medical or surgical treatment."

VETERANS' CARE

On Capitol Hill, the perennial question of dental benefits for another group of government beneficiaries—war veterans—is again being debated in connection with annual appropriations for the Veterans Administration. The Senate approved $15,810,000 for fee-service payments, an increase of 10 million dollars over the figure that was voted by the House. Even this sum is nearly 7 million dollars below the amount that will be required, according to Veterans Administration officials, who pointed out that the House had abolished eligibility restrictions currently in effect. These officials predicted the result would be an unprecedented rise in demand for government-paid dental care.

The Senate recommended that the eligibility restrictions be reinstituted as of April 1, 1955. If the House concurs, it will mean that veterans may apply for treatment of service-connected dental conditions on or before March 31, 1955, or within one year after service discharge, whichever date is later. Applications received after the cutoff dates would be rejected.

It should be noted that this issue, which will be resolved by Congress, is independent of the VA regulation relating to so-called "one shot" care. This rules out repeated attention, except under mitigating circumstances as defined by the Veterans Administrator, and there

have been no signs that it will be modified in any way.

Still another matter of importance to dentistry which is due for early action by Congress has to do with income tax obligations of persons holding medical and dental fellowships. Heretofore the Internal Revenue Service has considered fellowship stipends to be excludable, provided the recipient was not bound in any way to fulfill a work obligation to the grantor. The House, however, had proposed that stipends be subject to tax if they exceeded 75 per cent of the recipient's income in the previous year.

Numerous scientists and representatives of philanthropic groups protested to the Treasury and Senate Finance Committee that enactment of such a scheme would prove a serious deterrent to acceptance of fellowships in the health sciences. The committee declined to grant blanket excludability for fellowship compensation but agreed that it should be tax-free up to $300 a month, for a maximum of three years.

Since the Treasury has given assent to such liberalization, House concurrence is anticipated when the tax revision bill comes up for final debate, which probably will be in June.

DENTAL RESEARCH FUNDS

John W. Knutson, chief dental officer of U. S. Public Health Service, went before the Senate Appropriations Committee on May 12 to testify on the progress of fluoridation, federal support of dental research and other activities under his general supervision. Inasmuch as government officials are prohibited from asking for higher sums than the Budget Bureau has approved, Dr. Knutson could only hint at the inadequacy of funds requested for dental research.

"Last year the American people spent over $1 billion for dental care," he said. "The Federal government is also expending appreciable sums in this area. During fiscal year 1953, more than $100 million was spent to provide dental services for the Armed Forces, veterans, and other direct Federal beneficiaries. It should be pointed out that these expenditures offer no promise of a permanent solution to the Nation's dental problems. Moreover, adequate dental services, despite these measures, reach less than a third of the American people.

"Obviously, the logical approach to the dental problem—the only practical, long range approach—is through research and development of preventive and control procedures. . . . The National Institute of Dental Research conducts a grants program to help finance basic research in dental schools and other non-Federal institutions. For the past five years, the annual appropriation has remained at the same level—$221,000. With this sum we help support annually about 24 active research projects. By the very nature of the diseases under study, most of these projects are long-term and only a few new ones can be started each year."

Dr. Knutson concluded, "The disparity between dental needs and services received in this country is beyond dispute. . . . The Nation's annual expenditure of over a billion dollars for dental care represents about one-eighth of the American consumer's expenditure for health services. This figure, however, does not tell the whole story. It is almost impossible to measure accurately the loss in production through diminished efficiency and industrial absenteeism occasioned by dental illness.

"In view of these costs in dollars and ill health, it is evident that there are tremendous possibilities for savings from intensive research, prevention and control of dental disease."

Association Affairs

ASSOCIATION HEARD ON ANTI-FLUORIDATION MEASURE

Association representatives testified last week in Washington before the House Interstate and Foreign Commerce Committee against proposed legislation seeking to ban fluoridation of community water supplies throughout the nation. The bill, H.R. 2341, which was introduced by Representative Roy W. Wier of Minnesota, is opposed by all major health organizations.

Testifying for the Association were H. Trendley Dean of the Council on Dental Research, J. Roy Doty of the Council on Dental Therapeutics and E. Harold Gale, chairman of the Council on Legislation.

"It should be remembered," Association spokesmen pointed out, "that over a period of many years extensive and numerous surveys and studies have failed to reveal any hazard to health from the ingestion of drinking water containing fluoride ion in concentration of 1 ppm." On the contrary, they said, there is ample proof of the value of fluoridation. Its safety and value have been demonstrated by observation of its effects on animals and human beings. Its value has also been demonstrated in communities using fluoridated water and in pilot fluoridation studies. Statistics show that 20,000,000 persons in the United States are already drinking fluoridated water.

In information bulletins issued during May, the A.D.A. pointed out that fluoridation is being opposed in very much the same manner as were both chlorination and pasteurization. Yet today, both are accepted as commonplace.

Many scientific and professional groups favor fluoridation. Twice within the past three years the National Research Council investigated the relationship of fluorine to dental health. The Council, which is closely connected with the government through the charter of the National Academy of Sciences, is composed largely of accredited representatives of about 85 national scientific and technical societies. It was established on a permanent basis in 1918 by order of President Wilson. The National Academy of Sciences, with which it is connected, was established almost a century ago. Its charter was signed by President Lincoln. As a result of the investigations of the National Research Council, the Council is on record for fluoridation.

Among other groups endorsing this measure are the American Medical Association, the American Public Health Association, the U. S. Public Health Service and the American Hospital Association. The American Cancer Society issued a statement recently which said that, contrary to the claims of some fluoridation foes, the drinking of fluoridated water will not cause cancer. All of the A.D.A.'s constituent societies in the 48 states and the District of Columbia have endorsed fluoridation.

The Wier bill reads:

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, that no agency of the government of the United States (including the government of the District of Columbia, and of each territory and possession of the United States), and no agency of any state, or of any municipality or other political subdivision of a state, shall treat any public water supply with any fluoride compound, or make any water so treated available for general use in any hospital, post office, military installation, or other installation or institution owned or operated by or on behalf of any such agency."

ASSOCIATION ACQUIRES LAND FOR OFFICE EXPANSION

A lot 25 feet wide situated immediately west of the present Central Office building was acquired recently by the Association, announced Leslie M. FitzGerald, Association president. The land will be used, Dr. FitzGerald said, for construction within the next year of an addition to the present building.

The new lot was exchanged for one previously owned by the Association which was not adjacent to the Central Office building. Additional space has been needed for several years as a result of the increased activities of the Association.

Negotiations for the property were conducted by L. H. Jacob, chairman of a Special Committee on Association Headquarters of the Board of Trustees; Harold Hillenbrand, secretary, and John J. Hollister, business manager. Other members of the Special Committee are Lewis Thom, tenth district trustee, and H. B. Washburn, treasurer.

PROJECTED CLINICS TO BE FEATURE OF ANNUAL SESSION

The May 17 meeting of the Council on Scientific Session held in the Central Office gave particular attention to the projected clinics program which is planned for the Association's 95th annual session November 8-11 in Miami, Fla. A minimum of 38 different projected clinics will be given, the Council announced.

This is the first time that projected clinics will be a feature of the scientific session. The clinics will be 20 minute demonstrations of technics in which the clinicians will use visual aids such as slides to help in the demonstration. The clinics will be held Wednesday and Thursday mornings, November 10 and 11.

Walter H. Campbell of Miami Beach, Fla., is in charge of the projected clinics program. There are still a few vacancies in the program, and those having colored slides or other material which might be of interest are requested to write to Dr. Campbell, 541 Lincoln Road, Miami Beach, Fla.

INVITE MIAMI DELEGATES TO GESU CHURCH MASS

A mass will be held in Gesu Church in Miami, Fla., Sunday, November 7, for delegates and their families the day prior to the opening of the Association's 95th annual session, which is scheduled for November 8-11 in Miami. The mass will be held at 10:30 A.M. in the Upper Church.

Gesu Church is located in the heart of downtown Miami. Father Harold A. Gaudin is church pastor.

HAROLD HILLENBRAND NAMED TO W.H.O. DELEGATION

Harold Hillenbrand, Association secretary, has been named by President Eisenhower as official adviser to the United States delegation to the annual meeting of the World Health Organization, which opened May 4 at Geneva, Switzerland. The United States delegation includes three official delegates, all of whom are government officials, and six advisers. Chester Keefer, M.D., of the Department of Health, Education and Welfare, is chief delegate.

SCHEDULE FOR 1955 APTITUDE TESTS ANNOUNCED

Three dental aptitude tests have been scheduled for applicants to the 1955 freshman classes, the Council on Dental Education has announced. The examinations will be held October 1 and 2, 1954; January 14 and 15, 1955, and April 29 and 30, 1955.

The Council has issued a new edition of the booklet, *Dental Aptitude Testing Program,* which contains information for prospective dental students. It explains predental requirements, the course of study in a dental school and the dental aptitude testing program. Copies of the booklet and application blanks for the aptitude test may be obtained either from the dental schools or from the Division of Educational Measurements at the Association's Central Office.

Also in a 1954 revision is the brochure *Requirements and Registration Data of State Dental Examining Boards.* The brochure which includes information of interest to dentists planning to apply for state board examinations may be obtained from the Council on Dental Education at the Central Office.

UTAH ACCEPTS NATIONAL BOARD EXAMINATION

The State of Utah has accepted the certificates of the National Board of Dental Examiners in lieu of the written examination conducted by the state for the licensing of dentists, it has been announced by Frank O. Alford, chairman of the Council of the National Board of Dental Examiners.

This brings to 28 the total number of states which accept the certificates and grades of the National Board as partial fulfillment of requirements for the practice of dentistry. Other agencies also are contemplating the recognition of the examination reports.

The next National Board examinations will be held December 6 and 7.

SCIENCE ACADEMY HONORS GEORGE C. PAFFENBARGER

George C. Paffenbarger, director of the Association Fellowship Division of the National Bureau of Standards, has been elected to membership in the Washington Academy of Sciences. The action was taken at the Academy's Board of Managers' meeting April 20.

In a letter to Dr. Paffenbarger, the Academy wrote, "You were . . . . elected in recognition of your contributions to physical and chemical properties of dental materials."

Dr. Paffenbarger is the author of 40 published reports on dental materials and coauthor of the book *Physical Properties of Dental Materials.* He is president of the International Association for Dental Research.

SOCIETIES REMINDED OF LIFE MEMBERSHIP DEADLINE

Secretaries and executive secretaries of constituent societies have been reminded that a rule of the Board of Trustees requires all applications for life membership in the Association be received in the Central Office not later than 60 days in advance of the annual session. This means that the latest date at which life membership applications will be accepted for 1954 is September 8.

COUNCIL TO LAUNCH NEW PUBLICATION

A new annual publication listing specifications and certifications of dental materials will be launched later this year by the Council on Dental Research, it was decided at the Council's meeting April 22-23 at the Central Office.

The publication, *Dental Materials Specification and Certification Annual,* will be the first of its kind and will report on the work of the Association Fellowship at the National Bureau of Standards.

Dangers of Dental Radiography, a new film produced by the Association's Research Fellowship at the National Bureau of Standards, was shown at the Council meeting. The film, available for

viewing by professional audiences only, illustrates the elementary physics of dental roentgenography.

The Council on Dental Research heard also a report by Edward G. Hampp, Association Research Fellow at the National Institutes of Health, on research on oral spirochetology and on a study of smooth surface caries being carried on in rats at the National Institute of Dental Research.

Lt. Col. Martin L. Segal (left) presents a $36 check to C. Willard Camalier, Association secretary, for the Association Relief Fund. The check was from the 13 members of Class number 11 of the Army Medical Service Graduate School and was presented to Dr. Camalier at the graduation exercises April 30 in Washington.

EXPECT TO PRESENT VIEWS ON DEPENDENT CARE

Representatives of the Association are expected to testify early in June before the Senate Armed Services Committee on a new Defense Department bill for dental and medical care of military dependents. The bill generally limits dental care to emergency treatment, a limitation favored by the Association.

A policy statement on military dependent care approved in April by the Board of Trustees pointed out that "during periods of extensive mobilization of citizens for military service, the Armed Forces have experienced serious difficulty in providing adequate dental services to military personnel." In view of this difficulty, the statement said, dental officers should provide dental care to military dependents only in emergencies or at overseas installations and in remote areas in the United States where civilian dental facilities are not available.

Association spokesmen testified before Senate and House Committees May 25 and 26 on appropriations for dental activities of the United States Public Health Service. Representing the Association was Floyd W. Pillars of the Council on Legislation.

In urging that additional appropriations be made, Dr. Pillars pointed out that dental research is receiving too little in relation to the need for research and in relation to the amounts appropriated for other health activities. In spite of the prevalence of dental disease the proposed 1955 budget for the dental health activities of the USPHS is $10,000 less than the budget of the previous fiscal year.

A request by the Council on Legislation for a new hearing on an Army dental bill which seeks a reorganization of the Army Dental Corps has been turned down by the House Armed Services Committee.

A.D.A. TO PARTICIPATE IN UNESCO COUPON SCHEME

The American Dental Association will participate in the UNESCO Coupon Scheme, it has been announced. The Coupon Scheme is designed to facilitate the purchase of publications, educational films and scientific materials internationally.

In the past the Association has had difficulty in supplying demands for its materials abroad because requesters often were unable to obtain dollars with which to pay for the desired publications.

Under the UNESCO plan, which should ease the difficulty, an institution or individual wishing to purchase material from another country may buy UNESCO coupons in the requester's own country's currency at its dollar rate (subject to whatever restrictions his government has made on such purchases). The requester then sends the coupons to the supplier in payment of the purchase. UNESCO will redeem the coupons in the currency of the supplier, less a five per cent discount.

Thus purchasers in Europe wishing to purchase educational material from the A.D.A. may do so by paying in UNESCO coupons which the Association can redeem in dollars, less the discount.

APPOINTMENT BOOK FOR 1955 IS NOW AVAILABLE

The 1955 appointment book, published by the Association for dentists in private practice, is now available and may be obtained from the Order Department of the Central Office. The price is $2.00. Payment should accompany the order.

The appointment book is laid out so that the dentist can see his week's appointments at a glance. It designates the principal national and religious holidays. A feature of the book is the recall section in which the dentist can list the dates of recall appointments as far as 12 months in advance. Some 15,000 copies of the appointment book are used yearly.

"X-RAYS AND YOUR TEETH" BOOKLET REVISED BY COUNCIL

X-Rays and Your Teeth, an illustrated booklet explaining the importance and the use of roentgenograms, has been revised by the Council on Dental Health. The booklet is written for the prospective dental patient and discusses the use of roentgenograms in the detection of cavities, impacted teeth and periodontal disease. Sample copies are available from the Council on Dental Health at the Central Office, 222 E. Superior Street, Chicago 11.

Five other booklets also have been revised. *Attractive Teeth for Teen-Agers* has a new cover and new format as well as a revised text. Available in a 1954 revision are *Diet and Dental Health*, *Tommy's First Visit to the Dentist*, *Fluoridation in the Prevention of Dental Caries* and *How to Obtain Fluoridation for Your Community*.

QUARTERLY DENTAL INDEX CONTAINS 1,279 REFERENCES

The first quarterly issue of the 1954 *Index to Dental Literature*, which is now available, contains 1,279 entries, announced Donald Washburn, director of the Bureau of Library and Indexing Service. The *Index* lists all known original articles, editorials, reprints, abstracts and obituaries published in the English language in dental journals since December 31, 1953.

The cost of a single subscription for one year is $30. Additional subscriptions to the same subscriber are $15. Further information on the *Index* may be obtained from the Bureau of Library and Indexing Service at the Central Office.

TROUBLESOME TERMS TO BE WORKSHOP TOPIC

"Troublesome Terms—a Workshop on Perennial Problems in the Dental Vocabulary" will be sponsored by the Bureau of Library and Indexing Service as the third conference on nomenclature scheduled for September 3-4 at the Central Office. The conference will be under the direction of George B. Denton, research consultant.

Persons wishing to receive the preliminary circulars which are being issued to explain the work of the conference and

those interested in participating in the workshop may receive information by writing to Donald Washburn, director of the Bureau of Library and Indexing Service at the Central Office.

STUDENT MEMBERSHIP BOOKLET DISTRIBUTED TO SENIORS

A new booklet for student members of the Association has been distributed by the Council on Membership. Entitled *Information for 1954 Senior Dental Students,* it describes the various types of membership which are open to graduating student members. Copies have been sent to secretaries of constituent societies and to all dental schools for distribution to senior dental students.

ADDITIONAL STATES QUALIFY FOR ASSOCIATION INSURANCE

During the first two weeks in May, two additional state societies, Kentucky and Maryland, enrolled 50 per cent of their membership in the Association Accident and Health Insurance program and thus made possible the coverage of their members who are impaired risks. A total of 13 states and Hawaii had qualified as of May 17. They were Alabama, Arizona, Florida, Idaho, Kentucky, Maryland, Montana, New Mexico, North Dakota, Rhode Island, South Carolina, Virginia and Wyoming. As of May 17 also, the Association was within 2,000 applications of reaching the national goal.

There was a strong possibility that additional states would reach their quotas by the June 1 cutoff date, Paul Zillmann, insurance trustee, announced.

At press time there were 13 states which needed 60 applications or less to make their quotas.

The National Casualty Company's plan is already in effect in California, Nevada, New Jersey, New York and Utah.

FACTS FOR DENTISTS IN TWO BUREAU BOOKLETS

The booklet entitled *Facts About States for the Dentist Seeking a Location,* published by the Bureau of Economic Research and Statistics, has been issued in a 1954 revision.

The purpose of the booklet is to help the graduating dentist or the dentist who intends to relocate to decide in which state he should practice. It contains such information as the distribution of dentists and population by region and state, average income of dentists in the various regions and states, provisions of state dental practice acts and state income tax rates.

A second booklet, *Distribution of Dentists in the United States by State, Region, District and County,* also has been brought up-to-date. "The distribution of dentists throughout the country differs markedly from the distribution of population," the booklet points out. "Undoubtedly many dentists have chosen locations without the benefit of facts on the distribution of dentists and population." The booklet provides these facts.

Copies of both booklets have been sent to senior dental students who are members of the Association. Single copies may be obtained free of charge from the Order Department at the Central Office.

NEW "DAREDEVIL DAVEY" BOOK ANNOUNCED BY ASSOCIATION

Daredevil Davey Breaks the Time Barrier, the sixth in the series of children's dental health comic books, has been published by the Division on Dental Health Education.

In the booklet Daredevil Davey, with the aid of an ingenious time device, travels through past centuries and sees how dental problems were handled by people living then. Davey compares the old methods with the new to show how it is

possible today for boys and girls to achieve good dental health.

Copies of the booklet are available from the Central Office. Prices are: $2.85 for 25 copies; $5.15 for 50 copies, and $8.85 for 100 copies.

CONFERENCE TO EVALUATE DENTAL LIBRARIES' SERVICE

Representatives of the Council on Dental Education and the Bureau of Library and Indexing Service will meet in Washington June 12 and 13 with dental librarians to evaluate the services performed by dental libraries. Replies to a questionnaire mailed to librarians will provide the conference with information on the services and facilities offered by dental school libraries. The conference will study the questionnaire replies and will set up standards which dental librarians can use to evaluate their services.

Dental Societies

EUGENE DIONNE SELECTED FOR MASSACHUSETTS BOARD

Eugene Dionne, president of the Massachusetts Dental Society, has been appointed to the Massachusetts Board of Dental Examiners. Dr. Dionne is the third member of a state board which has as its other two members George J. Fink and Arno Bommer, president-elect and vice-president respectively of the Massachusetts Society.

The Oregon Dairy Council served 40 gallons of milk and over 40 pounds of cheese to dentists attending the 61st annual meeting of the Oregon State Dental Association in Portland March 1-3. In the photo above, Grace Workmen of the Dairy Council serves Frank Mihnos of Portland and David Witter of the Oregon State Board of Health.

PLAN TO STAFF RURAL AREAS ENDORSED BY SOCIETY

A dentist placement program designed to meet the need for dentists in rural areas and small towns has won the approval of the Virginia State Dental Association. The association's endorsement came at its annual meeting held in Richmond, Va., April 12-14.

The program is sponsored by the Virginia Council on Health and Medical Care, which has a similar program in operation for the placement of physicians. Under this program, the Council acts as a placement center where physician-short communities may find physicians seeking a place to practice. Over 50 physicians have been placed by the Council in the last two years.

William N. Hodgkin, former member of the A.D.A. Council on Dental Education, has been appointed chairman of the state dental society committee which is to work with the Council. One of the first steps will be to acquaint students at the School of Dentistry, Medical College of Virginia, with the service.

Harry J. Lyons, dean of the school and speaker of the A.D.A. House of Delegates, said he believed the dental placement service would be of great value to

young dentists and to dentist-short communities.

It was pointed out that in communities where the Council had stimulated the construction of small clinic buildings to attract physicians, facilities could be added for dentists.

Dental Education

SYMPOSIUM SCHEDULED ON PERIODONTAL PROBLEMS

A symposium on periodontal problems under the direction of Helmut A. Zander will be held September 11 and 12 at the University of Minnesota in Minneapolis. Under discussion will be (1) tooth mobility—its objective measurement, causes and correction; and (2) the epithelial attachment—its role in health, disease and calculus formation and the effect on the attachment apparatus of filling materials used in dentistry.

Participating in the discussion will be Jens Waerhaug of Oslo, Norway; Hans R. Mühlemann of the University of Zurich, Switzerland, and Helmut A. Zander of the University of Minnesota.

SCHOOLS OFFER GRADUATE AND POSTGRADUATE PROGRAMS

Beth Israel • The teaching division of the dental department of Beth Israel Hospital announces a two week conference and seminar in periodontology September 13-24. The object of the seminar is to present the theoretical background of and the technics used in periodontal therapy. Further information may be obtained from the coordinator of education programs, Beth Israel Hospital, 330 Brookline Avenue, Boston 15.

California • Five courses are being offered by the University of California Extension in Los Angeles. A step-by-step procedure for occlusal equilibration will be taught June 19-21; a course in complete dentures, June 25-27; dentistry for children, July 11-16; indirect inlays with hydrocolloid and stone models, July 16 and 17, and newer dental materials and technics, July 30, 31 and August 1.

Further information may be obtained from J. Eugene Ziegler, University of California Extension Dental Program, 815 S. Hill Street, Los Angeles.

Also offered is a course in crown and bridgework under the direction of Stanley D. Tylman. The course is scheduled for July 19.

North Carolina • Postgraduate summer courses at the University of North Carolina School of Dentistry, Chapel Hill, will run from June 14 to August 6, the school has announced. Courses offered include dentistry for children, July 12-16; endodontics, June 21-25, or June 30, July 7, 14, 21 and 28; inlays, August 4-6, and periodontology, June 14-16.

Northwestern • The advanced course on cephalometric radiography previously announced by Northwestern for June 7-9 has been scheduled for June 21-23. The course is open to orthodontists who have had some training and experience in cephalometric radiography. Further information may be obtained from the director of graduate studies, Northwestern University Dental School, Chicago, Ill.

National Defense

NEW THERMOMETER DEVELOPED BY COLONEL PERKINS

A new clinical thermometer has been developed by Col. George T. Perkins, director of the Dental Division of the Army Medical Service Graduate School, Wal-

ter Reed Army Medical Center, the Army announced May 13. The new thermometer is said to be more accurate and much faster than the present mercury type. It can give a temperature reading in 5 to 7 seconds and is accurate to within one tenth of a degree.

The surgeon general's office said the new electronic device is "the first change in clinical thermometers since the mercury column type was introduced in 1867."

In addition to increased speed and accuracy, the instrument has the advantage of being able to record temperatures by remote control, Colonel Perkins said. He envisions "having all the beds in a ward wired so that patients could place a thermometer under their tongues or arms and a nurse at a distant part of the ward could read their temperatures off a meter."

Commander Phelps J. Murphey (DC, USNR) received the Legion of Merit Award March 15. The award was given for outstanding service in pioneering and developing the acrylic eye for disabled servicemen.

NO NEED SEEN FOR EXTENSION OF DENTIST DRAFT LAW

Barring a change in the international situation, the Defense Department will not ask Congress to extend the dentist-physician draft law beyond its expiration date of June 30, 1955, Maj. Gen. George E. Armstrong, Army surgeon general, has told Congress.

By 1955 there should be enough graduates from the dental schools to assure an adequate supply of professional health manpower for the Armed Forces, the A.D.A. Council on Federal Dental Services has said, and, therefore, there should be no need to extend the dentist-physician draft law.

ADMIRAL DELANEY RETIRES, NAVY OFFICER FOR 36 YEARS

Rear Admiral Henry R. Delaney was placed on the disability retired list on May 1 after more than 36 years of active duty as a Navy dental officer. At the time of his retirement, he was inspector of

Daniel F. Lynch, president-elect of the Association, is shown at the Navy Dental School in Bethesda, Md., April 30 with the commanding officer of the School and navy dental officers from three foreign countries. These officers are (l. to r.): Capt. Ralph W. Taylor, (DC) USN, the School's commanding officer, Lieut. Asdrubal Novaes, of Brazil, Lt. Cmdr. Man Su Kim of Korea, Dr. Lynch and Lt. Col. Alexander C. Lemen of Canada.

Admiral Delaney

Navy dental activities on the Atlantic coast.

Admiral Delaney was graduated from Tufts College Dental School. He received a Master of Science degree at Georgetown University in 1934. During this time he served as White House dental surgeon.

Admiral Delaney is a member of the New York Academy of Dentistry, Omicron Kappa Upsilon, the Association of Military Surgeons and the American Dental Association. He is also a Fellow of the American College of Dentists.

Capt. F. W. Lepeska has assumed Admiral Delaney's duties as inspector of the Navy dental activities on the Atlantic coast and as district dental officer of the Third Naval District.

This portrait of Maj. Gen. Walter D. Love, retired chief of the Army Dental Corps, has been presented to Walter Reed Army Medical Center and was unveiled in Washington April 24. It was the gift of dental officers around the world.

Public Health

CANCER SOCIETY SAYS FLUORIDATION SAFE

The American Cancer Society has again stated that water fluoridation is without danger so far as cancer is concerned. In a letter to E. Aubrey Cox, physician of Wichita Falls, Tex., where opponents of fluoridation were using the rumor that fluorides in the water cause cancer, Charles S. Cameron, M.D., president of the American Cancer Society, said, "The American Cancer Society does not consider fluorine or the common fluorine salts to be carcinogenic."

Dr. Cameron pointed out that a study by the U.S. Public Health Service showed no significant difference between fluoride and nonfluoride cities in the death rates of either cancer or heart disease.

EVANSTON CHILDREN HAVE SOUND TEETH, STUDY SHOWS

Evanston children now enjoy excellent dental health, according to a report released in May by Winston H. Tucker, M.D., commissioner of health of that city.

Comparison of the 6 to 8 year age group with the same age group in 1946, the year before fluorine was added to the water, shows a 56 per cent decrease in caries incidence. "While a constantly increasing health consciousness on the part of parents might in itself bring about some improvement," stated Commissioner Tucker, "the dramatic results shown here in some 2,500 children must be interpreted as reflecting the fluorine program."

The community of Oak Park, which has the same water supply as Evanston but which does not fluoridate its water, has been used for comparison purposes in the study. The teeth of Oak Park children have not shown improvement in any way comparable to that of the teeth of the children in Evanston, the study shows.

International

FIVE U.S. DENTISTS TO GO TO F.D.I. MEETING THIS MONTH

Five members of the Association have been chosen delegates to the 42nd annual meeting of the Fédération Dentaire Internationale, to be held June 8 through 13 in Scheveningen, the Netherlands. Harold Hillenbrand, Association secretary, will head the delegation.

Other delegates are LeRoy M. Ennis, Association past president; C. Willard Camalier, assistant secretary; John Knutson, dental chief of the U.S. Public Health Service, and Arno M. Bommer, vice-president of the Massachusetts Dental Society. Included among the alternates will be L. Herbert Loeb of Boston. Oren A. Oliver, chairman of the Council on International Relations and F.D.I. president, also will attend.

ALL INDIA ASSOCIATION ANNOUNCES OFFICERS

H. D. Merchant of Bombay has been elected president of the All India Dental Association for 1954. Elected vice-presidents are U. S. Malik of Calcutta Dental College; M. L. Watts of Amritsar Dental College, and K. M. Gandhi of Bombay. Fali S. Mehta is the new honorary general secretary and R. M. Narelvala honorary joint secretary. Honorary assistant secretary is R. B. Raut. N. R. Vazifdar is honorary treasurer.

AMERICANS INVITED TO TAKE PART IN CONGRESS

An invitation has been extended to American dentists to present their work and to take part in the table clinics of the congress of the 28th Journées Dentaires de

Alumni of the Chicago College of Dental Surgery and of the University of Southern California College of Dentistry are shown with their wives at an affair held April 20 in Honolulu, Hawaii, to honor Robert McNulty, dean of the University of Southern California College of Dentistry. Dean and Mrs. McNulty are in the second row, fourth and fifth from the left.

Paris. The congress will take place November 24-28. Communications may be addressed to J. Ouvard, secretary-treasurer, 33 Avenue Pierre 1 de Serbie, Paris 16.

Research

STUDY EFFECTS OF FRUITS AND BEVERAGES ON TEETH

A grant has been made by the Florida Citrus Commission of Lakeland, Fla., to J. F. Volker, dean of the University of Alabama School of Dentistry, to study the effects of orange juice, grapefruit juice and selected carbonated beverages on the enamel surface of teeth, it was announced in May. Seventy young adults have been selected for the study on the basis of the suitability of the labial surfaces of their upper anterior teeth for the taking of collodion relief replicas. The experiment will continue for four months.

General

COLORADO FOUNDATION PLANS ROENTGENOLOGY SEMINAR

A seminar on roentgenology and roentgenography will be held June 20-24 in Colorado Springs, Colo., under the sponsorship of the Colorado Dental Foundation.

The program includes essays, group luncheons and demonstrations. Members of the seminar will be encouraged to prepare cases for group discussion on diagnosis or on technic.

Essayists participating in the conference include Harry Sicher of Loyola University School of Dentistry (Chicago); Beryl Ritchey, member of the American Academy of Oral Roentgenologists; Edward C. Stafne, head of the section on dentistry of the Mayo Clinic; Juan A. del Regato, director of the Penrose Cancer Hospital; Joseph P. Weinmann, University of Illinois College of Dentistry, and William J. Updegrave of Temple University School of Dentistry. Howard R. Raper of Albuquerque will be a conference guest.

ROUND TABLE FORUM PLANNED FOR INSTITUTE MEETING

The annual meeting of the American Institute of Dental Medicine will be held in Palm Springs, Calif., October 31 to November 4. A round table forum is planned as a feature of the meeting.

Gordon M. Fitzgerald of the University of California will speak on various aspects of roentgenography; Maynard K. Hine of Indiana University, on the treatment of periodontal disease; Ernest Jawetz, M.D., of the University of California, on virus infections of interest to the dentist; Joseph P. Weinmann, M.D., of the University of Illinois, on adaptation of the periodontal membrane to physiologic and pathologic changes; William A. Albrecht, Ph.D., of the University of Missouri, on soil and nutrition, and Charles H. Best, M.D., of the University of Toronto, on the history and action of insulin.

CLEVELAND SPEECH CENTER DEDICATED MAY 14

A $506,000 building for the Cleveland Hearing and Speech Center was dedicated May 14, it has been reported. The new building and its special equipment will enable the Center to expand its services and research program for the benefit of those who are handicapped by speech or hearing defects. The center is said to be the newest structure of its kind in the United States. Howard Kessler represents the dental profession on the Center's board of trustees.

LIST HIGHLIGHTS OF LIBRARY ASSOCIATION MEETING

The Medical Library Association will hold its 53rd annual meeting June 15-18 in Washington, D. C. The official host is the Armed Forces Medical Library.

Highlights of the program are tours of the National Institutes of Health, of the National Naval Medical Center and of the Armed Forces Medical Library. Delegates to the meeting will be addressed by Detlev Bronk, president of the Rockefeller Institute of Medical Research; Lt. Col. Frank B. Rogers, director of the Armed Forces Medical Library; Verner Clapp, acting librarian of Congress, and Raymond Zwemer, chief, Library of Congress' science division.

Donald A. Washburn, director of the American Dental Association's Bureau of Library and Indexing Service, is assistant business manager of the Medical Library Association. Dental school librarians will have a section at the annual meeting.

LEO SICHEL ERRONEOUSLY LISTED AS DECEASED

Leo Sichel of San Francisco was erroneously listed as deceased in the May issue of THE JOURNAL, as the result of an incorrect report received in the Central Office. THE JOURNAL wishes to apologize for the error.

DENTAL CARE INSURANCE PLAN UNDER WAY IN NEW YORK

Group Health Dental Insurance, Inc., the first voluntary prepayment dental insurance plan in the United States to be sponsored by a dental society, got under way in New York during May. The sponsor is the First District Dental Society of the State of New York.

The Plan is open to subscribers and their dependents when the subscribers are members of an employed group of 60 or more persons of whom at least 75 per cent enroll.

Services are to be rendered in the offices of the participating dentists. Subscribers have the free choice of any participating dentist, and a dentist may refuse to accept any patient. Invitations to participate will be issued shortly to all dentists in the New York area.

The patient is expected to bear the cost of correcting dental defects which exist at the time of enrollment. (The Plan pays costs over $150.) With the exception of orthodontic treatment, the Plan will provide the services necessary to maintain good oral health.

SOCIETY PROTESTS USE OF LOLLIPOPS IN POLIO PROGRAM

Health officials in Morristown, N. J., have 3,600 lollipops which will not be eaten as the result of a protest by the Tri-State Dental Society, it was reported May 1. The candy was to be given to children getting the Salk polio vaccine shots. The Dental Society protested that the confection would be detrimental to the children's teeth. Candy was omitted from the polio program.

SAMUEL BRANDON NAMED HEAD OF ANESTHESIA SOCIETY

Samuel A. Brandon of Portland, Ore., was elected president of the American Society for the Advancement of General Anesthesia in Dentistry at its meeting March 22 in New York City. Elected vice-presidents were William L. Chalmers of Toronto, Canada; Harold F. Kedian of Watertown, Mass., and Leonard M. Monheim of Pittsburgh. M. Hillel Feldman of New York was elected executive secretary.

International Correspondence

NEWS FROM GREAT BRITAIN

With the thought that news from Scotland might be interesting to many of the readers of THE JOURNAL, Professor J. Aitchison, dean of the University of Glasgow Dental Hospital and School, has very kindly sent me the following notes.

SCOTTISH DENTISTRY

All three Scottish dental schools, Dundee, Edinburgh and Glasgow, have agreed to accept a number of Norwegian undergraduates until the projected Norwegian dental school at Bergen can relieve the present excess of Norwegian dental students from Oslo. Professor Aitchison of Glasgow gave a course in Oslo last winter to the Norwegian dental students and to members of the Norwegian Dental Association. Later he lectured at Copenhagen in a postgraduate psychology course organized by the Danish Dental Association. Some 420 Danish dentists enrolled for this course.

Professor Hitchin of Dundee is at present lecturing in Norway and Sweden. Dr. Kerr McNeill of Glasgow has been sent to Norway by the British Council on the invitation of the Norwegian Minister of Education to teach his method of nonsurgical closure of clefts of the hard palate. Dr. McNeill will visit Copenhagen later at the invitation of the Danish Orthodontic Society; he may lecture in Sweden also.

The Royal College of Surgeons of Edinburgh has now formed its dental council, which will be known as the Dental Faculty when the ancient Charter of the College has been revised to safeguard legally the College's old privileges. The following fellows in dental surgery have been appointed to the dental council: Professor Aitchison of Glasgow, Professor Boyes of Newcastle, Mr. Gibbs of Edinburgh, Professor Hitchin of Dundee, Professor Hutchinson of Edinburgh, Mr. Logan and Mr. Middleton of Edinburgh. At the first meeting of the dental council, Mr. Gibbs was elected president and Mr. Russell Logan, secretary.

DENTAL SHIP FOR THE HEBRIDES

Residents of the Hebrides have always found it difficult to obtain dental treatment, especially if they live on the smaller islands. It has been necessary for them to travel by steamer or fishing smack to the nearest point on the mainland of Scotland or to one of the larger islands where there is a practicing dentist.

Two dentist brothers from Glasgow have bought a former air-sea rescue launch and transformed it into a floating dental surgery. The crew will consist of a seaman, a dental mechanic, a nurse receptionist, who will also cook, and the two dentists who are both keen sailors. The surgery contains a dental unit, a chair and a nitrous oxide and oxygen machine; a waiting room has been built on deck. The intention of the brothers is to treat the Islanders under the National Health Act scheme. The launch will be roped to piers and jetties on the larger islands. It is intended to find sheltered bays by the smaller islands and to ferry the patients out to the floating surgery. What will happen to the staff and an anesthetized patient if an Atlantic swell arises during an operation or if a destroyer passes outside the bay and sets up a gigantic wash? The answer of the staff is, "Wait and see." The Constance, as the ship is called, set out on its initial dental cruise on April 4, 1954.

DENTAL RESEARCH ASSOCIATION

Prof. Martin Rushton reports on the second annual meeting of the British section of the International Association for Dental Research. The meeting took place at Birmingham University in April and was attended by about 40 members and a number of invited guests. Although one whole day had been allotted for the delivery and discussion of short essays, the number of papers accepted had to be restricted to correspond with the time available: some were read by title only, and others had to be declined. Since the only material acceptable is unpublished matter either in progress or recently completed, this is a healthy sign, and it is possible that more frequent meetings will have to be arranged.

The Section is certainly fulfilling its function of enabling those engaged in dental research to get to know one another well and to expose their current work to each other's criticism. Most of the papers concerned laboratory studies—biochemical, histological, histochemical, microradiographical, tissue and virus

culture—and many aroused vigorous argument.

During the morning session, news was received of the death of Sir J. Frank Colyer, and the proceedings were interrupted while the members stood in silence. Sir Frank Colyer, honorary curator of the Odontological Museum, was the greatest authority on early dental instruments. In appreciation of his work, the section of odontology of the Royal Society of Medicine in 1922 created the Colyer Prize, which is awarded for dental research. In 1952, Sir Frank published *Old Instruments Used for Extracting Teeth*. There is not a dental library or a collector anywhere that does not possess a copy. As befits a great man, Sir Frank was unassuming and was never too busy to share his knowledge promptly and willingly.

NATIONAL HEALTH SERVICE

John Gilbert gives us the following additional information on remuneration of dentists. The British Dental Association has demanded a restoration of the 10 per cent cut in the scale of fees and a comprehensive review of the whole standard and method of remuneration under the General Dental Services of the National Health Service. The Ministry of Health has answered that it was not prepared to consider either of these requests until it was in possession of adequate knowledge of the existing levels of remuneration of practitioners working in the General Dental Services. The British Dental Association, aware of the fact that the original fees were negotiated without exact data being available to either the Government or the Association, had little option but to agree to an inquiry into the earnings and expenses of practitioners working in the Service.

The information required is being obtained in two ways: (1) by a questionnaire sent directly to 4,700 practitioners (one half of those in the General Dental Service) seeking details of their hours of work, their expenses and remuneration and (2) by returns to be provided by the income tax authorities of the audited incomes of practitioners. This latter information has been obtainable only because the British Dental Association has agreed that such figures shall be supplied by the Income Tax Authority and only with the guarantee that the figures cannot possibly be related to individual practitioners and that complete anonymity is assured.

The material from the two sources will be examined and tabulated by actuaries appointed by the Government and the Association, and the statistics provided by these two unimpeachable experts will form a basis for the negotiations.

NEWS OF GENERAL INTEREST

The British Society of Dental Hypnotists held its third meeting February 2. A lecture entitled "Hypnosis and the Problems of Childhood" was given by Dr. Gordon Ambrose, vice-president of the British Society of Medical Hypnotists.

Entries to the three Scottish Dental Schools have dropped from 155 in 1946 to an estimated figure of 70 in 1953.

In the school dental service in Scotland the number of dental officers had increased from 100 in October 1951 to 161 in December 1953—the highest number ever reached.

The total membership of the British Dental Association on December 31, 1953, was 10,816.

Dr. G. Scott Page of Tunbridge Wells was installed as president of the American Dental Society of London at its annual meeting held April 21.

Gerald H. Leatherman, D.M.D., F.D.S.R.C.S.

Policy statement on military dependent care

In mid-April the Board of Trustees by mail vote adopted a statement of policy applicable to federally financed dental care for dependents of military personnel. The policy statement was submitted to the Board by the Council on Federal Dental Services. The Council pointed out to the Board that a legislative plan to revise the present program for providing health services to military dependents was scheduled to be introduced before Congress in April and that certain provisions in the plan were not covered adequately by existing Association policy. All indications are that the plan will be sponsored by the Department of Defense as an administration bill in an effort to fulfill President Eisenhower's recommendations for improving the incentives and emoluments of the career military service. It is almost certain, moreover, that Congress will act on the legislation before adjournment. The policy statement is intended to apply generally to the federal government's obligation to finance health services for military dependents and to apply particularly to the important features of the legislative plan which were disclosed at a February conference of Association representatives and officials of the Department of Defense.

The American Dental Association is fundamentally opposed to any plan for providing federally financed health care to a particular class of persons unless there is reasonable justification for the federal government to assume that obligation. Within limitations, Congress may, of course, be justified in considering the provision of health services for military dependents as an indirect form of compensating certain categories of military personnel; therefore, whether the health care of military dependents should be financed in whole or in part by the federal government as an indirect form of remuneration for members of the military establishment or as a desirable emolument of their military service is, in the final analysis, a policy decision that should be left to the discretion of the Congress.

The American Dental Association, however, is concerned with the adverse effects that any plan for providing dependent dental care may have upon the quantity and quality of dental care available to personnel in active military service and, concomitantly, upon the balance that must be maintained between the dental manpower allocated to the military and that which remains to serve the civilian community. On the other hand, should Congress choose to authorize a program of dental care for military dependents to be provided by civilian dentists, the American Dental Association would, of course, be vitally interested in the method proposed for providing that care.

Finally, the Association believes that it has a legitimate interest in urging that Congress demand that all essential aspects of a plan for providing health benefits to military dependents be clearly defined and that the cost of the program be accurately estimated by those sponsoring the plan. The American Dental Association, therefore, recommends that the following principles be applied to any proposal for providing federally financed dental care to dependents of military personnel.

1. Should Congress decide that a program of federally financed health services for military dependents is justified as an indirect form of remunerating members of the military establishment or as a desirable emolument of their military service, the benefits of the program should be confined to those to whom that justification applies.

2. The primary mission of military dental officers is to maintain and improve the dental health of military personnel. More specifically, the military dental services are charged with the responsibility of confining to the practical minimum the loss of active duty time caused by dental disorders. No consideration should be given, therefore, to any plan which may require military dental officers to undertake assignments that would jeopardize their primary mission of caring for the dental needs of military personnel.

3. During periods of extensive mobilization of citizens for military service the Armed Forces have experienced serious difficulty in providing adequate dental services to military personnel. During periods of extensive military mobilization, therefore, military dental officers should not be used to provide dental care to military dependents except within the following limitations:

a. To provide for the immediate critical needs of dependents in strict emergency situations.

b. To provide essential dental care to dependents in overseas installations and in remote areas within continental United States where civilian dental facilities are not available. Dependents scheduled to go overseas under military sponsorship should be required to bring their dental conditions to a state of maintenance.

4. The meaning of "emergency dental care," "essential dental care," "remote areas," and such other critical terms in any basic legislation authorizing dependent dental care should be strictly defined so that the emphasis will be upon a minimum use of military dental officers for the care of military dependents.

5. If the plan authorizes dental care adjunctive to medical or surgical treatment, that type of care should be strictly limited to hospitalized patients in accordance with the customary procedure for joining the efforts of medicine and dentistry in the best interests of the patient. The American Dental Association is opposed to any plan which places the physician in the position of deciding and prescribing what dental services a patient may need.

6. Should Congress choose to authorize a program of dental care for military dependents to be provided by civilian dentists, that program would be acceptable only under the following conditions:

a. The dental services to be provided and the method of supplying those services should be clearly defined. The program contemplated should be formulated and administered in accord with the principles of the American Dental Association applicable to government financed dental treatment programs.

b. Payment of fees should be determined by authorized representatives of the dentists who will render the dental services and should be consistent with the provision of a high grade of dental service. Fees should be paid directly to the dentists who provide the services.

c. Should the program envision extensive dental services, priority should be given to the treatment of children.

7. The cost of services to be provided under any proposal for providing health care to military dependents should be accurately estimated by those sponsoring the plan so that Congress will be able to determine whether that cost fits within present and prospective budgetary limitations.

Book Reviews

AN INVENTORY OF SOCIAL AND ECONOMIC RESEARCH IN HEALTH

Compiled by Frederick R. Strunk. 1953 edition. 180 pages. Indexes. No price listed. New York, Health Information Foundation, 1953.

This is the second annual inventory of social and economic research in health. It is a "compilation of current and recently completed research projects dealing largely with the social and economic aspects of health programs and health problems" and is designed for use by research personnel and others interested in health problems.

The book describes 250 research projects. The dental projects involved consider both caries and services, and cover ten different areas of study in socio-economics in dentistry. It is recommended for all interested in research in dentistry.

In addition to describing the research projects, the book gives information on the nature of the problem, area considered, data and analysis, project staff, research organization involved, cooperating agencies and duration of project. Indexes, in five sections, cover subject, personnel, organizations, geographic area and other sources of information.

Harry Strusser

HEALTH TEACHING IN SCHOOLS FOR TEACHERS IN ELEMENTARY AND SECONDARY SCHOOLS

By Ruth E. Grout, M.P.H., Ph.D. Second edition. 353 pages with 23 illustrations. Appendixes A to E. Price $4.25. Philadelphia, W. B. Saunders Co., 1953.

It is refreshing to find that the author at the outset states that this book serves a threefold purpose: (1) to provide the teacher with current information on the health needs of the child; (2) to highlight principles and procedures of modern education and show how these may apply in health teaching; (3) to furnish the teacher with concrete materials to help carry out effective health teaching.

These principles are effectively carried out in ten chapters which deal with various details of the nature and methodology of health education.

The eleventh chapter is devoted to the role of co-workers in the field of health education, the use and integration of the varied types of health information and services made available by the groups.

The chapters on guides to health teaching include dental health information for the various grades. Each chapter is well documented and summarized and presents "selected readings."

Appendixes A, B and C give general references, suggested journals, sources of health education materials and the content of health courses in a selected high school. Appendix D deals with the problem of alcohol, tobacco and narcotics; Appendix E, with the problem of assuming individual responsibility for group health. The book has many features which will be very helpful.

Harry Strusser

EXISTENTIAL PSYCHOANALYSIS

By Jean-Paul Sartre. 275 pages. Translation and an introduction by Hazel E. Barnes. Index. Price $4.75. New York, Philosophical Library, Inc., 1953.

The two essays here presented are taken from Jean-Paul Sartre's "Being and Nothingness" (L'être et le néant). "Bad Faith" is the second chapter of part one. "Existential Psychoanalysis" is the second chapter of part four.

The present volume presents a detailed examination of the nature and kinds of being and of man's relation to himself and others. It lays down the outline of a new method for understanding the personality structure of the individual human being. In making this outline Sartre is, of course, following in the tradition of Freud and other psychoanalysts. In order to understand the troubles of their patients, these psychoanalysts have been forced to form conclusions as to the psychological structure of man and to decide what is to be taken as the normal development of a person who attains maturity and "adjustment."

In general, however, Sartre does not agree with Freud, Adler, Jung and others; he here blends philosophy and psychoanalysis based on the principles of existentialism. He criticizes traditional psychoanalytical schools and attempts to justify a method which interprets the human personality in terms of a fundamental choice of being. Man-in-the-world is the object of an examination which includes in its scope the "psychoanalysis of things."

R. M. Walls

Deaths

Hasbrouck, Theodore F., Fontana, Calif.; died December 16.

Lyon, George W., Glendale, Calif.; died December 18; aged 80.

Mahoney, Francis J., Worcester, Mass.; Pennsylvania College of Dental Surgery, Philadelphia, 1899; died October 9.

Marmon, Ervin F., Williamsport, Pa.; died January 18.

Martindale, Karl J., Morrison, Ill.; College of Dental Surgery, University of Michigan, 1901; died November 12; aged 74.

Mathieu, Wesley J., Kankakee, Ill.; Dental School, Northwestern University, 1901; died December 27; aged 74.

Mauch, Raymond G., Rib Lake, Wis.; Dental School, Marquette University, 1923; died October 1; aged 55.

McCaig, John J., Pittsburgh; died January 30.

McCoy, Clarence V., Bloomington, Ind.; Indiana Dental College, 1919; died November 29; aged 58.

MacDonald, D. J., Anaconda, Mont.; died December 9.

McNinch, Frank B., Philadelphia; Philadelphia Dental College, 1903; died January 19; aged 72.

Menges, George W., Elkhart, Ind.; American College of Dental Surgery, Chicago, 1894; died January 11; aged 83.

Messerschmitt, Frederick, Rochester, N. Y.; New York College of Dentistry, 1891; died January 17; aged 86.

Miller, Joseph S., Liberal, Kan.; School of Dentistry, Washington University, St. Louis, 1901; died February 8; aged 78.

Milstead, DeWilton H., East St. Louis, Ill.; School of Dentistry, Washington University, St. Louis, 1914; died January 7; aged 66.

Mix, Herbert H., Chautauqua, N. Y.; Philadelphia Dental College, 1902; died January 11; aged 80.

Moore, John R., Los Angeles; Kansas City Dental College, 1913; died September 17.

Murphy, Daniel W., Jr., West Hartford, Conn.; died February 17; aged 36.

Neuenschwander, Wilbur E., Fort Wayne, Ind.; Indiana Dental College, 1912; died January 5; aged 68.

Nief, Frederick P., Union City, N. J.; New York College of Dentistry, 1910; died February 12; aged 65.

Norwall, Alan H., San Francisco; College of Physicians and Surgeons, San Francisco, 1928; died November 7; aged 50.

Oman, Thoreau B., Baltimore; Baltimore College of Dental Surgery, 1895; died July 28; aged 81.

Ortman, Arthur H., Three Lakes, Wis.; Chicago College of Dental Surgery, Loyola University, 1927; died December 22; aged 55.

Owyang, George T., Columbus, Ohio; College of Dentistry, Ohio State University, 1927; died February 17; aged 59.

Oyler, William S., Buffalo, Okla.; College of Dentistry, University of Iowa, 1899; died January 21; aged 78.

Patenaude, Edward, Lowell, Mass.; died January 13.

Patrick, Casimer P., New York; died January 8; aged 55.

Patterson, Glen S., Detroit; College of Dental Surgery, University of Michigan, 1905; died November 17; aged 71.

Patterson, James H., St. Louis; Barnes Dental College, St. Louis, 1910; died January 22; aged 70.

Peck, James P., Kansas City, Mo.; Kansas City-Western Dental College, 1926; died June 6, 1953.

Pepperling, Theodore L., St. Louis; Missouri Dental College, St. Louis, 1890; died November 19; aged 84.

Perry, King S., Irwin, Pa.; Ohio College of Dental Surgery, University of Cincinnati, 1892; died December 16; aged 91.

Price, McFarland, Barnard, Mo.; Western Dental College, Kansas City, 1902; died November 29; aged 74.

Quinn, Edwin A., Brookline, Mass.; Dental School, Tufts College, 1892; died January 2; aged 87.

Rariden, Willard L., Farmington, Mo.; School of Dentistry, St. Louis University, 1916; died January 16; aged 58.

Rawson, Harry P., St. Petersburg, Fla.; School of Dentistry, University of Buffalo, 1897; died February 24; aged 78.

Reichel, Edwin J., Erie, Pa.; School of Dentistry, University of Pittsburgh, 1917; died January 16; aged 60.

Reichley, Jacob C., York, Pa.; Baltimore College of Dental Surgery, University of Maryland, 1904; died January 12; aged 71.

Roberts, George P., Tarpon Springs, Fla.; Ohio College of Dental Surgery, University of Cincinnati, 1901; died January 7; aged 81.

Rosenbaum, Harry L., Denver; New York College of Dentistry, 1914; died December 30; aged 67.

Ross, Charles, New York; died September 6.

Rouslin, John J., Pawtucket, R. I.; Dental School, Tufts College, 1919; died January 23; aged 58.

Samson, George D., Burlington, Vt.; New York Dental School, 1899; died January 29; aged 78.

Sanders, Albert E., Eureka, Calif.; College of Dentistry, University of Southern California, 1918; died February 16; aged 57.

Scherer, William H., Raymond, Ill.; Central College of Dentistry, Indianapolis, 1900; died January 17; aged 77.

Schwingen, William B., Wilkes-Barre, Pa.; School of Dentistry, University of Pennsylvania, 1921; died January 20.

Seltzer, Jacob W., Pottsville, Pa.; Philadelphia Dental College, 1902; died January 28; aged 75.

Shannon, James H., Stamford, Conn.; Baltimore College of Dental Surgery, 1922; died November 23; aged 55.

Singer, Charles L., New York; New York College of Dentistry, 1907; died January 25; aged 66.

Smith, Caroline H., Detroit; School of Dentistry, Temple University, 1916; died January 22; aged 68.

Smoot, Robert E., Tulsa, Okla.; Kansas City-Western Dental College, 1921; died December 2; aged 55.

Spinney, David F., Brookline, Mass.; Dental School, Harvard University, 1899; died February 3; aged 78.

Stanhope, Charles H., Brownville, Maine; died December 14; aged 78.

Stephens, Charles M., Davenport, Iowa; Des Moines College of Dental Surgery, 1905; died February 8; aged 74.

Stewart, Donald C., Franklin, Pa.; School of Dentistry, Temple University, 1932; died January 1; aged 45.

Stickel, Fletcher, Nevada, Mo.; School of Dentistry, Washington University, St. Louis, 1902; died December 25.

Strohmeyer, Walter J., Orient, N. Y.; New York College of Dentistry, 1907; died April 24, 1953; aged 69.

Sweeney, Robert J., Dubuque, Iowa; Keokuk Dental College, 1904; died June 19, 1953.

Swendiman, George A., Grand Forks, N. D.; Dental School, Northwestern University, 1913; died October 24; aged 66.

Sykes, William S., Cleveland; College of Dentistry, Ohio State University, 1898; died January 22; aged 77.

Temple, Raymond D., Anaheim, Calif.; College of Dentistry, University of Iowa, 1914; died February 16; aged 63.

Thurston, Robert F., Albert Lea, Minn.; College of Dentistry, University of Minnesota, 1919; died August 12; aged 60.

Trautman, Louis H., Sioux Falls, S. D.; College of Dentistry, Creighton University, 1930; died December 16; aged 47.

Tucker, Llewellyn C., Blackstone, Va.; Baltimore College of Dental Surgery, 1882; died November 2; aged 94.

Turley, Robert L., St. Louis; Barnes Dental College, St. Louis, 1913; died January 4; aged 62.

Van Brunt, William E., Tallahassee, Fla.; Baltimore College of Dental Surgery, University of Maryland, 1909; died December 11; aged 69.

Vickery, Bert W., Atchison, Kan.; Western Dental College, Kansas City, 1897; died April 14, 1953; aged 81.

Waddan, Jack, Washington, D. C.; Dental School, Harvard University, 1931; died October 2; aged 48.

Wagner, Victor R., Jamestown, N. Y.; School of Dentistry, University of Pennsylvania, 1910; died in June, 1953; aged 65.

Waldman, Herman J., Chicago; School of Dentistry, University of Denver, 1924; died November 12; aged 56.

Ward, Edward, Salt Lake City; Cincinnati College of Dental Surgery, 1900; died December 21; aged 78.

Wasson, John L., Mattituck, N. Y.; School of Dental and Oral Surgery, Columbia University, 1931; died February 12; aged 47.

Welch, Hermus S., San Diego; College of Dentistry, Ohio Medical University, 1904; died February 1; aged 72.

Wessell, George W., Santa Monica, Calif.; College of Dentistry, University of Southern California, 1907; died October 21.

Whitcomb, Fred F., Omaha; Omaha Dental College, 1904; died January 10; aged 73.

White, George E., Washington, D. C.; Dental Department, George Washington University, 1913; died in February; aged 73.

White, James A., Baltimore; College of Dentistry, Howard University, 1918; died March 24, 1953; aged 60.

Wilkerson, Benjamin L., Miami, Fla.; Baltimore College of Dental Surgery, 1907; died February 10; aged 75.

Williams, Neal D., Waynesville, Mo.; Western Dental College, Kansas City, 1911; died January 8; aged 61.

Wilson, William C., Salem, Mo.; School of Dentistry, St. Louis University, 1918; died November 28; aged 65.

Woodbridge, Howard J., Springfield, Mo.; College of Dentistry, University of Minnesota, 1930; died January 28; aged 50.

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THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION
222 East Superior Street, Chicago 11, Illinois
WHitehall 4-6730

LON W. MORREY, *Editor* JOHN J. HOLLISTER, *Business Manager*

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Announcements

MEETINGS OF THE AMERICAN DENTAL ASSOCIATION

Ninety-Fifth Annual Session	Nov. 8-11, 1954	Miami, Fla.
Ninety-Sixth Annual Session	Oct. 17-20, 1955	San Francisco
Ninety-Seventh Annual Session	Oct. 1-4, 1956	Atlantic City, N. J.

MEETINGS OF CONSTITUENT SOCIETIES

State	Date	Place	Secretary	Address
Alabama			F. A. Finney, Jr.	1045 Forrest Ave., Gadsden
Alaska	Aug. 2-5	Anchorage	C. J. Pearson	500 K St., Anchorage
Arizona			R. W. Christensen	17 E. Weldon Ave., Phoenix
Arkansas			D. M. Hamm	Box 89, Clarksville
California			L. R. Ludwigsen	450 Sutter St., San Francisco
S. California			J. P. Bowers	124 W. Lime St., Monrovia
Colorado	Oct. 3-6	Colorado Springs	W. R. Humphrey	724 Republic Bldg., Denver
Connecticut	June 2-4	Hartford	E. S. Arnold	37 Linnard Rd., W. Hartford
Delaware	Dec. 8	Wilmington	R. J. Zurkow	152 S. State St., Dover
District of Columbia	June 8	Washington	Z. B. Lloyd	2007 R St., N.W., Washington
Florida	Apr. 24-27, 1955	Jacksonville	J. E. Edwards	152 Alhambra Circle, Coral Gables
Georgia	Oct. 10-13	Atlanta	J. W. Yarbrough	Bibb Bldg., Macon
Hawaii	June 23-26	Honolulu	J. H. Dawe	810 N. Vineyard St., Honolulu
Idaho		Coeur d'Alene	F. O'Halloran	Box 703, Coeur d'Alene
Illinois			P. W. Clopper	623 Jefferson Bldg., Peoria
Indiana			E. E. Ewbank	Box 96, Kingman
Iowa			H. I. Wilson	639 Insurance Exchange Bldg., Des Moines
Kansas			F. A. Richmond	861 Brotherhood Bldg., Kansas City
Kentucky	Apr. 18-21, 1955	Louisville	A. B. Coxwell, Jr.	1976 Douglass Blvd., Louisville
Louisiana	Apr. 13-16, 1955	New Orleans	J. S. Bernhard	2515 Line Ave., Shreveport
Maine	June 24-26	Rockland	S. M. Gower	Box 27, Skowhegan
Maryland			E. L. Pessagno, Jr.	415 Medical Arts Bldg., Baltimore
Massachusetts			H. E. Tinsley	12 Bay State Road, Boston
Michigan			F. Wertheimer	Michigan Dept. of Health, Lansing
Minnesota	Mar. 28-30, 1955	Minneapolis	C. V. E. Cassel	242 Lowry Medical Arts Bldg., St. Paul
Mississippi	June 7-9	Biloxi	B. A. Cohen	306 Plaza Bldg., Jackson
Missouri	June 13-16	St. Louis	E. D. Suggett	201 Merchants Bank Bldg., Jefferson City
Montana			E. G. Vedova	Roundup
Nebraska			F. A. Pierson	1112 Federal Securities Bldg., Lincoln
Nevada	June 18-20	Lake Tahoe	O. M. Seifert	506 Humboldt St., Reno
New Hampshire	June 13-15	Whitefield	F. E. Williams	814 Elm St., Manchester
New Jersey			J. G. Carr	407 Cooper St., Camden
New Mexico			J. S. Ellar	Medical Arts Square, Albuquerque
New York			C. A. Wilkie	1 Hanson Place, Brooklyn
North Carolina			R. D. Coffey	Kibler Bldg., Morganton
North Dakota			V. B. Keltgen	517 de Lendrecie Bldg., Fargo
Ohio	Oct. 17-20	Cincinnati	E. G. Jones	185 E. State St., Columbus
Oklahoma			S. A. Russman	809 Medical Arts Bldg., Oklahoma City
Oregon	Mar. 7-9, 1955	Portland	T. D. Holder	308 Selling Bldg., Portland
Panama Canal Zone			A. L. Teitel	Box D, U.S. Naval Station, Rodman
Pennsylvania	Oct. 4-6	Pittsburgh	M. D. Zimmerman	217 State St., Harrisburg
Puerto Rico			L. de Jesus	Box 624, San Juan
Rhode Island	Jan. 1955	Providence	B. C. Friedman	2 Ayrault St., Newport
South Carolina			J. R. Owings	7 Medical Court, Greenville
South Dakota			L. N. Thelen	310A W. 18th St., Sioux Falls
Tennessee			W. L. McCulley	Brown Bldg., Cleveland
Texas			W. Ogle	3607 Gaston Ave., Dallas

State	Date	Place	Secretary	Address
Utah			R. C. Dalgleish	124 State Capitol Bldg., Salt Lake City
Vermont		Woodstock	W. J. Reardon	18 Madison St., Rutland
Virginia			W. T. McAfee	705 Colonial National Bank Bldg., Roanoke
Washington			W. B. Martin	Medical-Dental Bldg., Seattle
West Virginia	July 25-28	White Sulphur Springs	G. N. Casto, Jr.	710½ Lee St., Charleston
Wisconsin			R. A. Mason	964 N. 27th St., Milwaukee
Wyoming	June 20-23	Rock Springs	T. J. Drew	State Office Bldg., Cheyenne

MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

State	Date	Place	Secretary	Address
Alabama	June 21-24*†	Birmingham	W. L. McCarty	200 Professional Center, Montgomery
Alaska	July 19-22*†	Fairbanks	R. H. Williams	Box 2122, Juneau
Arizona	June 21-26*†	Florence	R. K. Trueblood	107 East A Ave., Glendale
Arkansas	June 21-25*†	Little Rock	H. O. Weatherly	205 Halter Bldg., Conway
California	June 21	Los Angeles	K. I. Nesbitt	507 Polk St., San Francisco
	July 26	San Francisco		
Colorado	June 21-25	Denver	J. M. Peabody	724 Republic Bldg., Denver
Connecticut	June 14-19*†	Bridgeport	C. G. Brooks	302 State St., New London
Delaware	June 28-30*†	Wilmington	P. K. Musselman	143 W. Main St., Newark
District of Columbia			W. T. Birthright	Suite 718, 1835 Eye St., N. W., Washington
Florida	July 12-22*†	Jacksonville	A. W. Kellner	P. O. Box 135, Hollywood
Georgia			S. H. Yarbrough	12 Medical Arts Bldg., Columbus
Hawaii	Sept. 1-6‡		H. L. Houvener	427 Dillingham Bldg., Honolulu
Idaho	June 28-30	Boise	R. E. Blickenstaff	1023 Fourth St., S., Nampa
Illinois			W. A. McKee	503 Wood Bldg., Benton
Indiana	June 15-18*†	Indianapolis	C. A. Frech	504 Broadway, Gary
Iowa			D. J. FitzGerald	615 Brick & Tile Bldg., Mason City
Kansas	June 14-17	Kansas City, Mo.	G. L. Teall	Box 71, Hiawatha
Kentucky	June 7-10	Louisville	R. M. Justice	1330 Central Ave., Ashland
Louisiana	June 6-10	New Orleans	R. C. Steib	833 Maison Blanche Bldg., New Orleans
Maine	June 28-30	Boston	R. A. Derbyshire	Box 387, Skowhegan
Maryland	June 7-9‡		H. Levin	3429 Park Heights Ave., Baltimore
Massachusetts	June 21-25*‡		G. J. Fink	Rm. 33, State House, Boston
	June 23-25†‡			
Michigan	June 6-12	Ann Arbor	J. L. Champagne	3714 W. McNichols Road, Detroit
Minnesota	June 14-18	Minneapolis	M. G. Walls	1470 Lowry Medical Arts Bldg., St. Paul
Mississippi	June 15-17	Jackson	J. C. Boswell	508 Lamar Life Bldg., Jackson
Missouri	June 7-12	St. Louis	R. R. Rhoades	414 Central Trust Bldg., Jefferson City
		Kansas City		
Montana	July 12-16	Helena	V. J. Quinn	301 Phoenix Bldg., Butte
Nebraska	June 7-11	Lincoln	H. E. Weber	1210 Federal Securities Bldg., Lincoln
Nevada	June 21	Reno	R. Whitehead	Suite 6, Masonic Temple, Reno
New Hampshire	June 18, 19	Boston	S. G. Markos	8 Renaud Ave., Dover
New Jersey	June 2-4*	Trenton	W. A. Wilson	150 E. State St., Trenton
	June 7, 8*	Philadelphia		
	June 14, 15*	New York		
	June 23, 24†	New York		
New Mexico	June 21-24	Santa Fe	J. J. Clarke, Sr.	Artesia
New York	June 24, 25*‡		D. W. Beier	23 S. Pearl St., Albany
	June 29-July 2*‡			
	June 24, 25†‡			
	June 29, 30†‡			
North Carolina	June 28-July 2	Chapel Hill	F. O. Alford	1109 Liberty Life Bldg., Charlotte
North Dakota	July 12-16	Fargo	A. L. Pushor	Lisbon
Ohio	June 17-19	Columbus	H. B. Smith	322 E. State St., Columbus
	June 21-23			
Oklahoma	June 28-30‡		R. P. Keidel	403 Surety Bldg., Muskogee
Oregon	June 14-17	Portland	F. L. Utter	506 Pioneer Trust Bldg., Salem
Pennsylvania	June 22-27*†	Philadelphia	A. M. Stinson	Dept. of Public Instruction, Box 911, Harrisburg
Puerto Rico			J. Mercado C.	Box 3717, Santurce

State	Date	Place	Secretary	Address
Rhode Island			F. M. Hackett	367 Academy Ave., Providence
South Carolina	June 17-19	Columbia	T. C. Sparks	1315 Pickens St., Columbia
South Dakota	June 20-23	Sioux Falls	H. T. Aker	Canton
Tennessee	June 14-18	Memphis	C. R. Alta	619 Bennie Dillon Bldg., Nashville
Texas	June 13-19* June 17-19†	Dallas	R. T. Weber	312 Capital National Bank Bldg., Austin
Utah	June 8-July 3‡		N. E. Munk	201 Cache Valley Bank Bldg., Logan
Vermont	June 28-30	Burlington	P. M. Fitch	Newport
Virginia	June 7-12* June 7, 8†	Richmond	J. M. Hughes	715 Medical Arts Bldg., Richmond
Washington			M. L. Mower	National Bank of Commerce Bldg., Olympia
West Virginia	June 21-23*†	West Liberty	C. A. Laughlin	613 Prunty Bldg., Clarksburg
Wisconsin	June 14-18*†	Milwaukee	S. F. Donovan	Tomah
Wyoming			W. A. Hocker	212 O & S Bldg., Casper

*Dental examination. †Dental hygiene examination. ‡Write to secretary of dental examining board for information on locations of examinations. §Approximate dates—verify with state dental examining board.

MEETINGS OF OTHER ORGANIZATIONS

Name	Date	Place	Secy. or Chm.	Address
American Academy of Gold Foil Operators	Nov. 6	Miami, Fla.	G. D. Stibbs Secy.	School of Dentistry, University of Washington, Seattle
American Academy of Implant Dentures	Nov. 6, 7	Miami, Fla.	E. J. Kresse Secy.	312 17th St., Denver
American Academy of Oral Roentgenology	Nov. 6	Miami, Fla.	E. A. Bourassa Secy.	1033 Medical and Dental Bldg., Seattle
American Academy of Periodontology	Nov. 4-6	Miami, Fla.	C. E. Chamberlain Secy.	115 North St., Peoria, Ill.
American Association of Dental Examiners	Nov. 5, 6	Miami, Fla.	C. A. Bumstead Secy.	924 Stuart Bldg., Lincoln, Neb.
American Board of Dental Public Health	Nov. 4, 5	Miami, Fla.	P. E. Blackerby, Jr. Secy.	250 Champion St., Battle Creek, Mich.
American Dental Assistants Association	Nov. 8-11	Miami, Fla.	M. L. Martin Exec. Secy.	410 First National Bank Bldg., LaPorte, Ind.
American Dental Society of Europe	July 6-9	Paris, France	J. P. Molony Hon. Secy.	110 Harley St., London W.1, England
American Denture Society	Nov. 5, 6	Miami Beach, Fla.	A. L. Roberts Secy.	Aurora National Bank Bldg., Aurora, Ill.
American Society of Oral Surgeons	Nov. 3-6	Hollywood, Fla.	R. F. Whalen Exec. Secy.	1112 E. Clay St., Richmond, Va.
Ark-La-Tex Dental Congress	Aug. 16	Shreveport, La.	M. Monsour Chm.	Medical Arts Bldg., Shreveport, La.
Austrian Dental Convention	Sept. 23-25	Innsbruck, Austria	F. Fischer Secy.	Tirolean Dental Society, Anichstrasse 35/1, Innsbruck, Austria
Council on Dental Education, Dental Aptitude Tests	Oct. 1, 2		S. Peterson Secy.	222 E. Superior St., Chicago
Federation Dentaire Internationale	June 8-13	Scheveningen, The Hague, Holland	G. H. Leatherman Secy. Gen.	35, Devonshire Place, London W.1, England
Fifth Annual Berkshire Conference	June 20-24	Falmouth, Mass.	I. Glickman	Tufts College Dental School, 136 Harrison Ave., Boston
Italian Congress of Dentistry and Stomatology Twenty-ninth Congress	Sept. 13-18	Venice, Italy	U. Saraval Dir.	Campo Manin 4017, Venice, Italy
New England Dental Society	Oct. 20, 21	Boston	F. L. Finley, Jr. Secy.	43 Farmington Ave., Hartford, Conn.
Ninth Pacific Coast Dental Conference	June 1-5	Banff, Alberta, Can.	H. B. Powell Secy.	Greyhound Bldg., Calgary, Alberta, Can.
Northeastern Society of Orthodontists	Oct. 25, 26	Buffalo	W. J. Prezzano Secy.	Medical Centre, White Plains, N. Y.
Seventh New Orleans Dental Conference	Oct. 24-27	New Orleans	V. B. Marquer Secy.	2213 S. Carrollton Ave., New Orleans
Southern Society of Orthodontists	Oct. 31-Nov. 3	Washington, D. C.	M. D. Edwards Secy.	132 Adams Ave., Montgomery, Ala.
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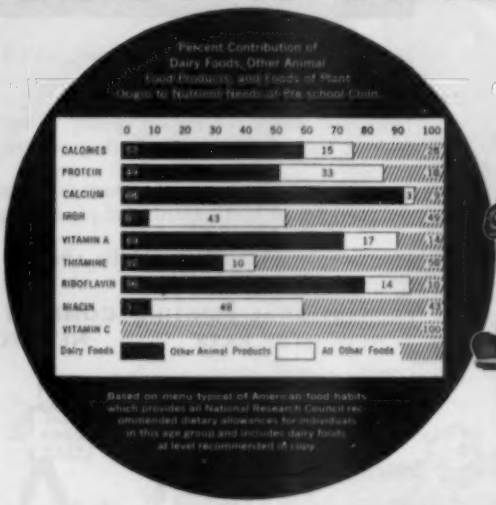
Percent Contribution of Dairy Foods, Other Animal Food Products, and Foods of Plant Origin to Nutrient Needs of Pre-school Child
0 10 20 30 40 50 60 70 80 90 100
CALORIES
PROTEIN
CALCIUM
IRON
VITAMIN A
THIAMINE
RIBOFLAVIN
NIACIN
VITAMIN C
Dairy Foods
Other Animal Products
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Learning to ride a bike or pushing a doll buggy around the block are part of the pre-schoolers big job of growing up — so is learning to eat a variety of foods, to meet the nutrient needs of growth and to establish good eating habits for a healthy life.

Protein is essential for the child's developing muscle, and for growth of bone as well. Milk and milk products are the primary source of protein in the diet of young children.[1] Eggs, meat, fish and poultry are also sources of high quality protein and should be included in the child's diet.

Calcium, phosphorus, and vitamin D are required for the normal calcification of bones and teeth, a continuous process during growth . . . even during the period of slow linear growth. One quart of vitamin D fortified milk per day will provide adequate quantities of these nutrients during pre-school years.[1]

Iron, copper, and certain other minerals are needed for red blood cell formation and as catalysts in various enzyme systems. These nutrients are provided by eggs, meats, fish, fruits, vegetables, and whole grain or enriched cereals.

All the essential vitamins must be provided for the formation and functioning of normal body tissues. Milk and milk products are the main source of *riboflavin* and of pre-formed *vitamin A* in children's diets . . . and provide some of all the other known vitamins.

Whole grain or enriched cereals and legumes supplement dairy foods and meats as sources of the *B-vitamins*. Citrus fruits, tomatoes, and other fruits and vegetables are needed as a source of vitamin C . . . and provide liberal amounts of vitamin A as well.

Energy for growth and activity is provided by all foods. More than 85 percent of the necessary calories come from fats and carbohydrates,[2] both of which are needed for adequate nutrition of the young child.[1] Butterfat is an excellent and dependable dietary fat for children of this age group.

Approximately one quart of milk, or its equivalent in other dairy foods—cheese, ice cream and butter—is recommended for inclusion in the diet of the normal young child every day.

[1]Jeans, P. C. Feeding of healthy infants and children. J. Am. Med. Assn. *142*:807 (March) 1950.
[2]*The National Food Situation*. NFS—60 U. S. Department of Agriculture, Washington, D.C. (April-June) 1952.

The presence of this seal indicates that all nutrition statements in the advertisement have been found acceptable by the Council on Foods and Nutrition of the American Medical Association.

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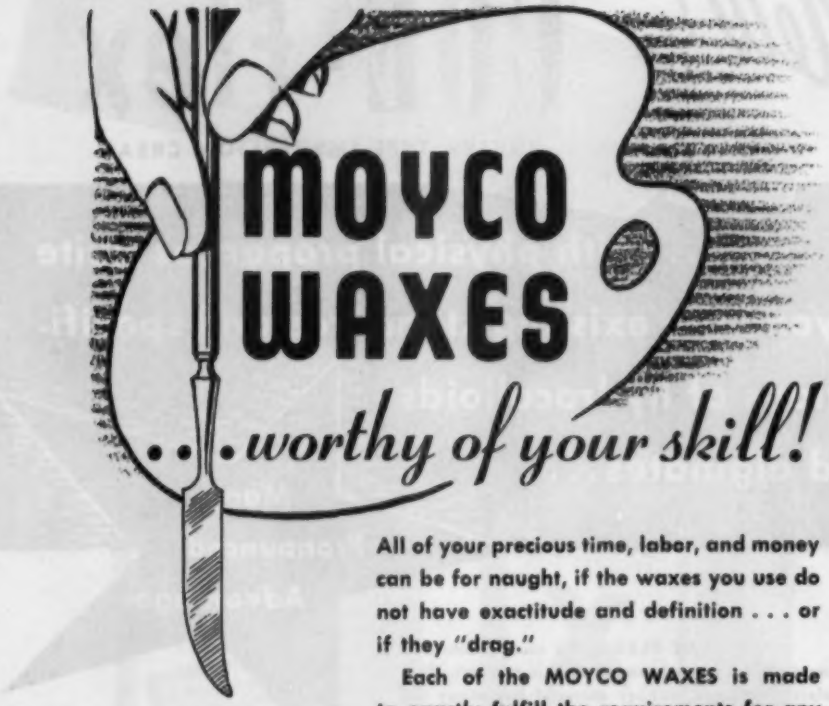

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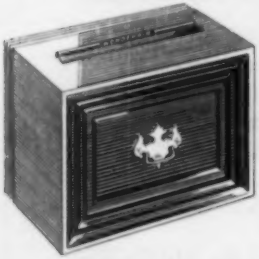

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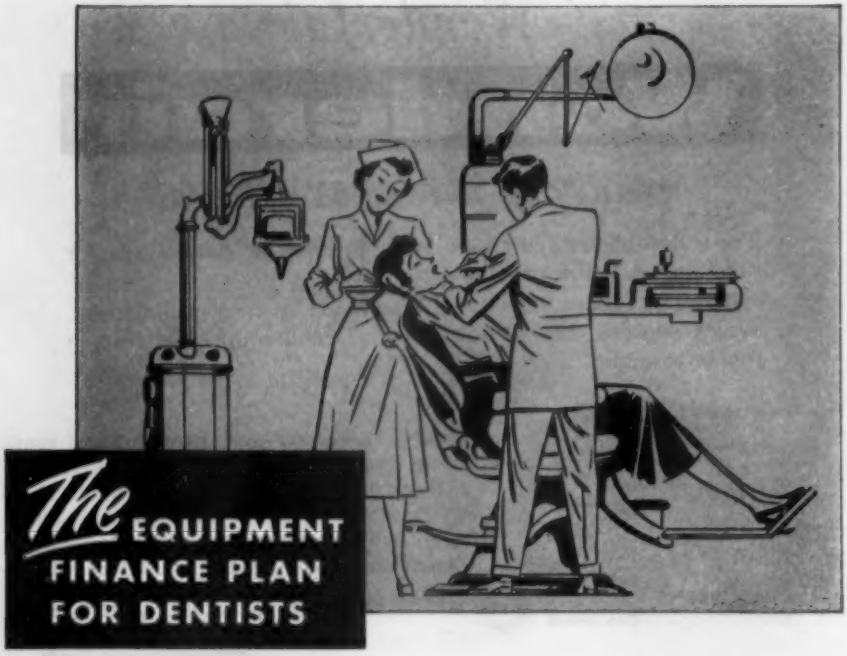

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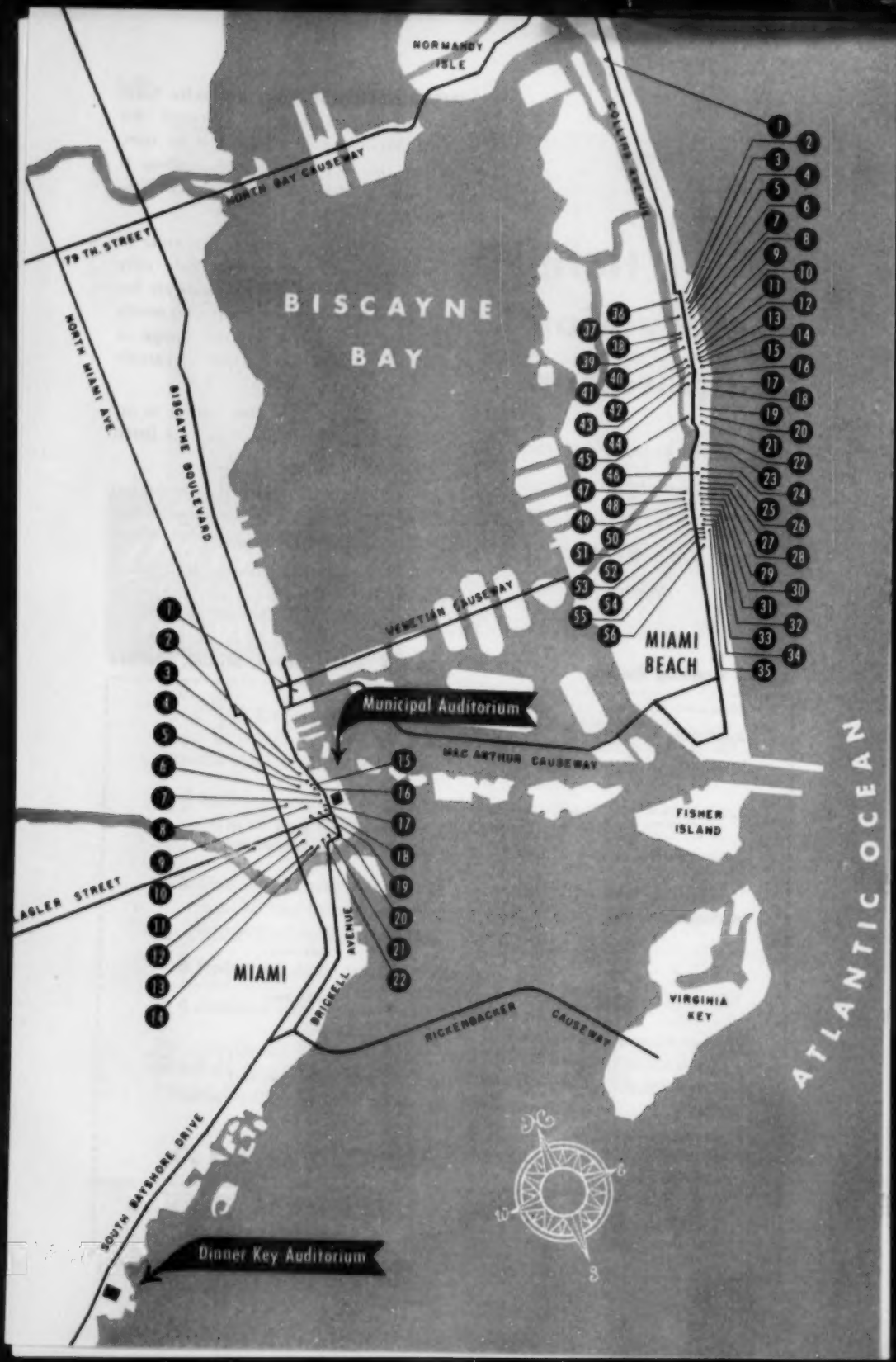
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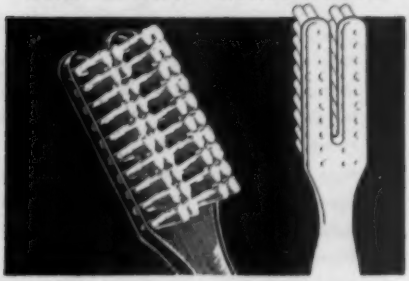

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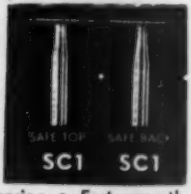

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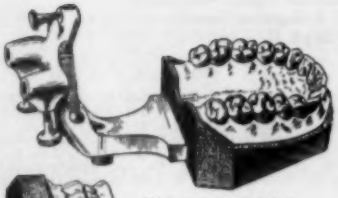

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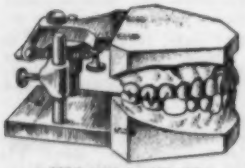

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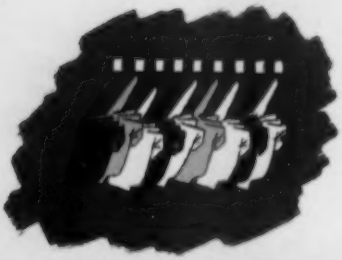

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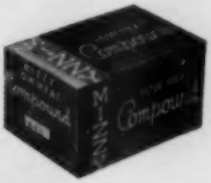

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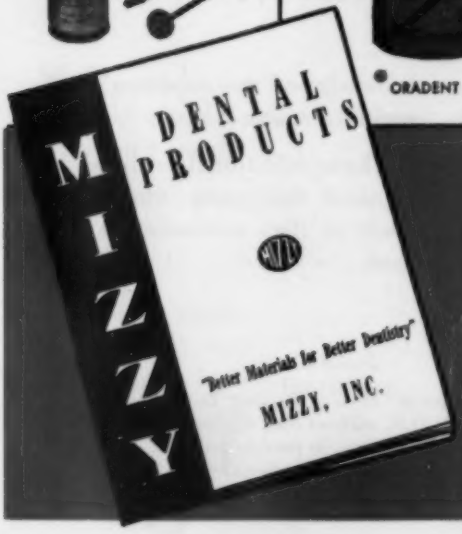

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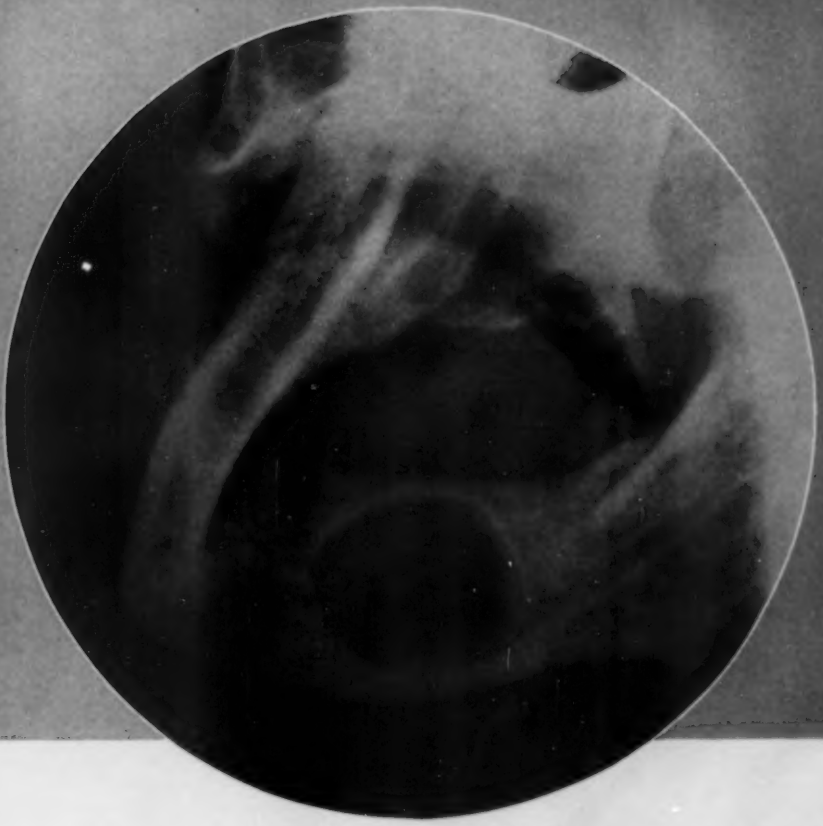

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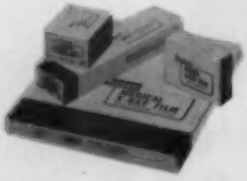

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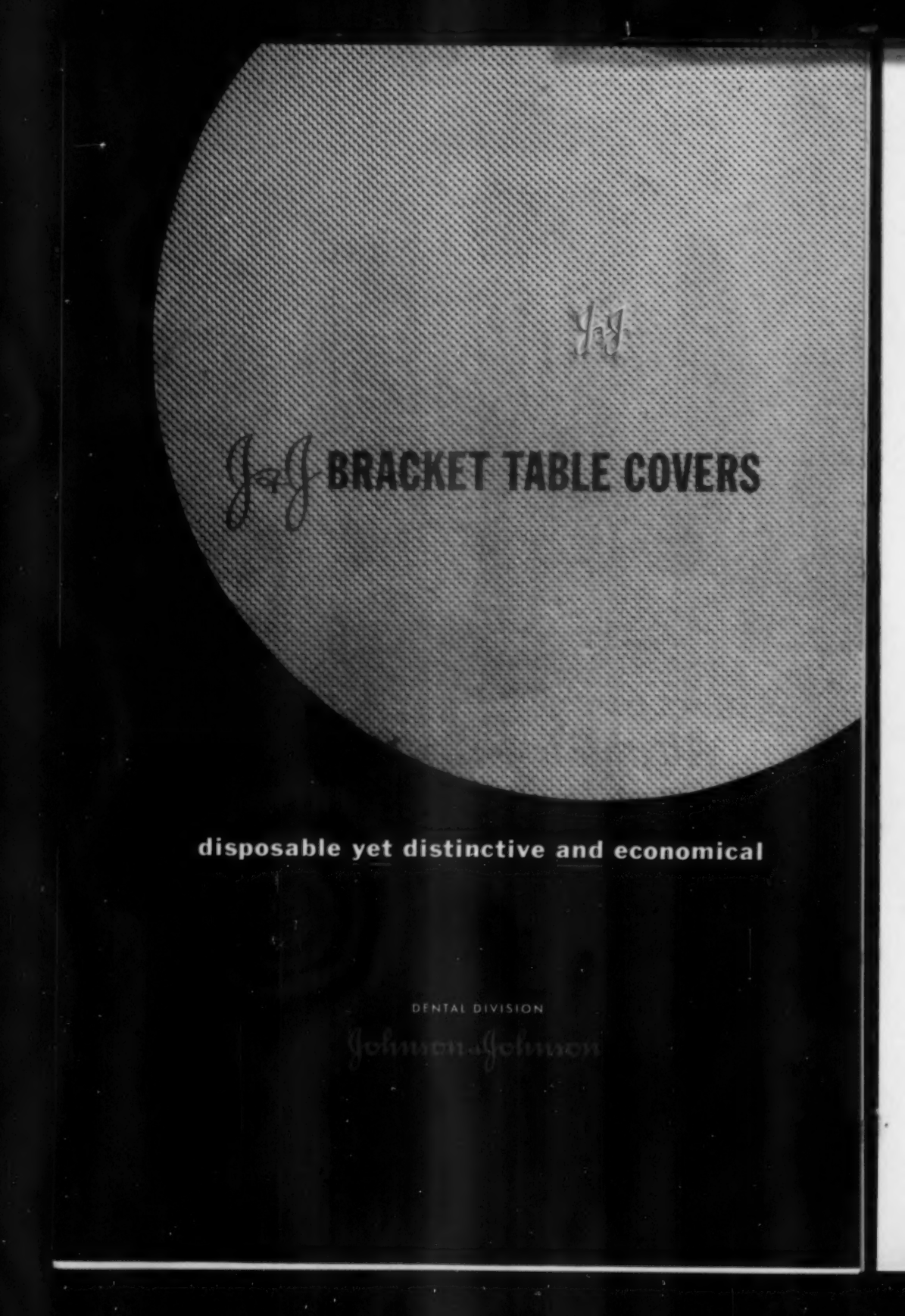
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Truly, the combination of colorfastness, CAVITY PRIMER and the *Brush-on* technic insures your complete satisfaction with the KADON filling.

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MONOCAINE 2ME provides deep, profound anesthesia without endangering delicate tissue cells. It was developed especially for those cases in which anesthesia is difficult to obtain. While MONOCAINE 1½% is recommended for routine use, MONOCAINE FORMULA 2ME is particularly desirable for jacket crown work, pulp extirpation and the preparation of bridge abutments.

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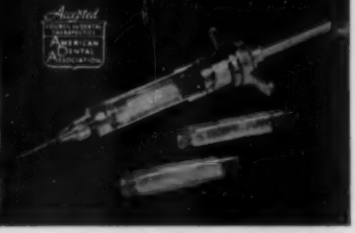

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Variegated colors, dispersed naturally and diffused through-and-through the denture as the material is mixed and cured, reproduce the same depth of coloration found in the tissues surrounding the denture.

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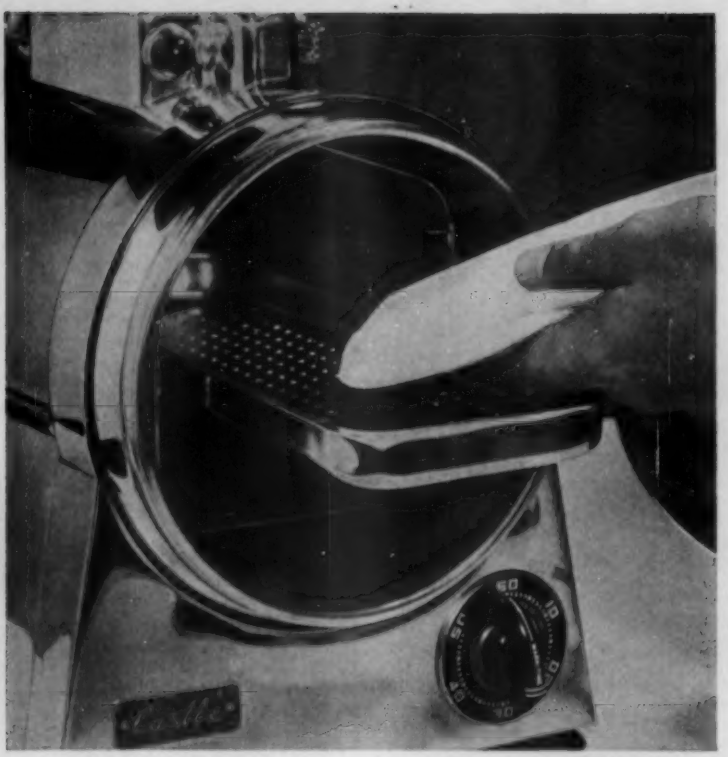

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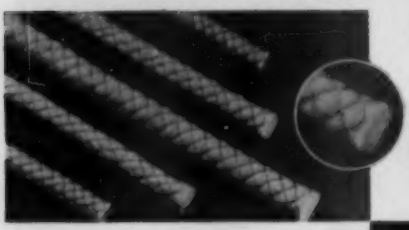

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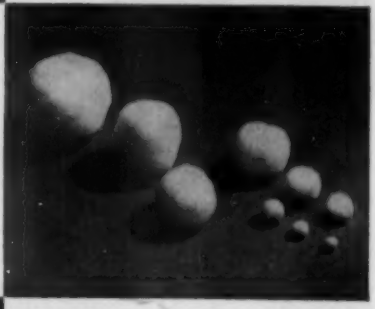

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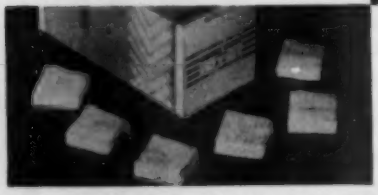

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Sterile or *non-sterile* packing. All gauze or cotton filled. Convenient, economical, absorbent. All cut edges lie in center.

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An effective topical anesthetic for use in the oral cavity. Circumvents patient apprehension prior to injection. Minimizes discomfort during normally painful deep scaling procedures. Useful wherever freedom from pain is an essential prerequisite to complete patient cooperation.
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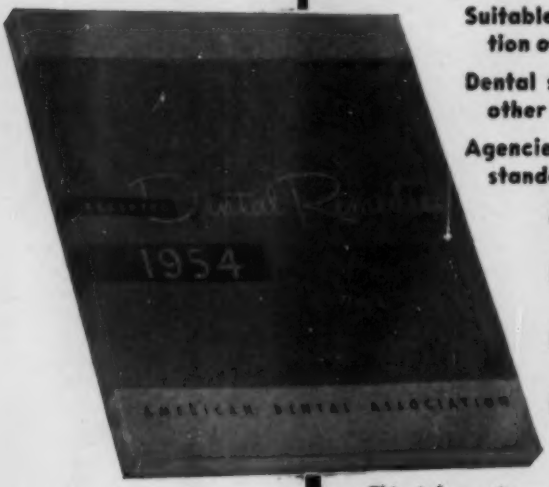

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Suitable conditions for disinfection of instruments?

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More than in any other, the casting phase requires exercise of strict quality controls, observation of precision instruments and faithful adherence to prescribed procedure. Equipment is specifically designed for the alloy and the technique. Temperature in the burn-out furnace, for instance, is carefully adjusted for each type of case and held at the proper point to condition the mold to receive the molten alloy under ideal circumstances. Only after controlled "soaking" is it ready for the casting machine.

Here the alloy becomes an important factor. Vitallium alloy is THE tested and certified alloy, unmatched for oral use. Each batch must pass rigid tests for strength, toughness, resilience and other qualities, which make it ideal for high-heat casting. It is one reason Vitallium has been selected by leading dental laboratories the world over. A scribe test will prove the precision of the technique. The same arc that was inscribed in wax will be faithfully reproduced in the casting. Examination of the casting will reveal it strong, tough, free of porosity and pits, with a surface smoothness that requires little polishing to produce the characteristic sparkle of Vitallium dentures.

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Quality Controlled for 21 Years

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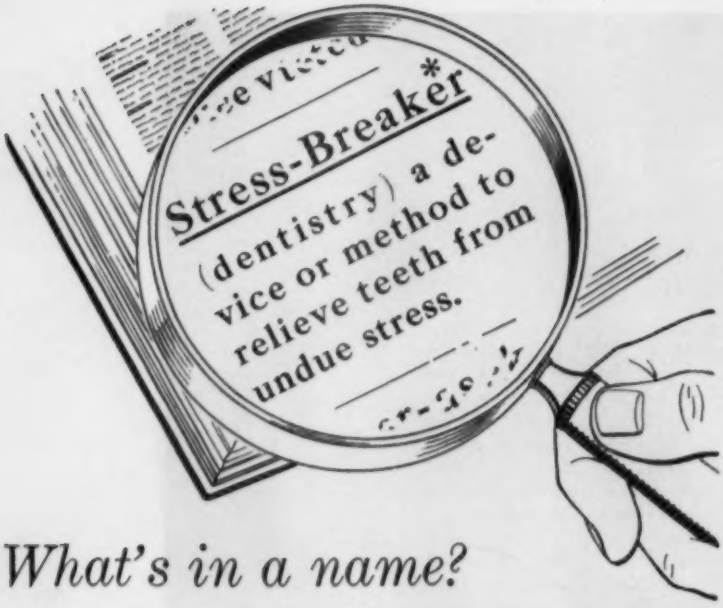

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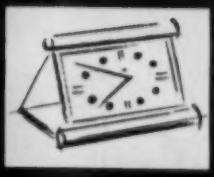

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and so a laxative of choice . . .

PHOSPHO-SODA (fleet)®

Purgative: — 4 teaspoonfuls or more before breakfast.

Aperient or mild laxative: — 2 teaspoonfuls before breakfast or before other meals, if indicated.

Administer in one half glass of water, followed by a second glass.

Phospho-Soda (Fleet) is a solution containing in each 100 cc. sodium biphosphate 48 Gm. and sodium phosphate 18 Gm.

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Also Gentle . . . Prompt . . . Thorough
the FLEET ENEMA
in the "squeeze bottle" disposable unit

"...and be sure to take your VITAMINS!"

Extensive exodontia, particularly in the elderly patient, imposes increased vitamin requirements for tissue repair at a time when vitamin intake is understandably low. A balanced vitamin preparation is a dependable way to guard the patient's nutritional status.

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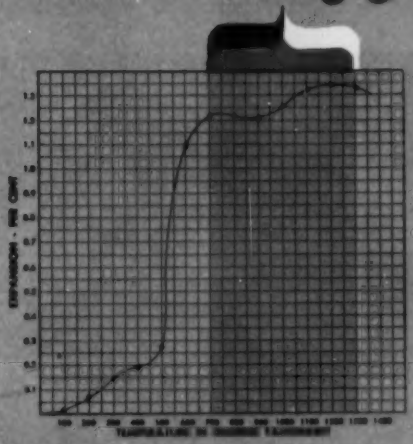
worthy of BAKER casting golds



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Baker Cristobalite Investment for inlays, bridges and large castings has a uniform expansion of from 1.2% to 1.3%—*over an exceptionally wide temperature casting range!* This is just what you need when making molds into which you cast precious metal alloys which shrink on an average of 1.25%.

Baker Cristobalite Investment has a hydrocal binder and a delicate combination of chemicals which impart great strength and extremely smooth mold surfaces. It washes away very easily under running water after casting.

This superior investment is available through your local depots in 5, 15, 50 and 100 lb. containers.

Our Cristobalite Model Investment is extremely hard and is also supplied in the same size containers.

***Cristobalite, discovered by Vom Rath in 1884 is now made synthetically from a special type of silica treated at very high temperatures and reground into selected size particles.**

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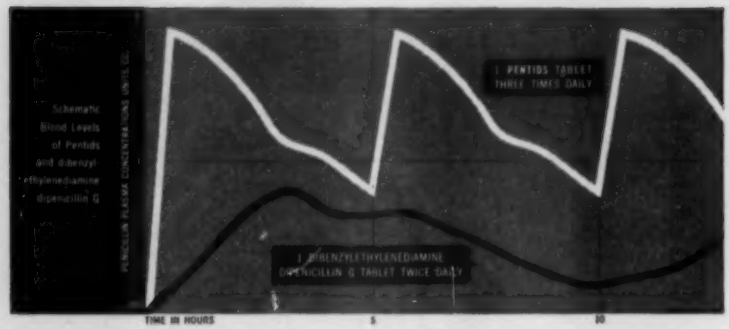

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Pentids are particularly effective as adjunctive therapy for acute oral Vincent's disease, pericoronitis, alveolitis, dento-alveolar abscess, cellulitis and osteomyelitis. Also for prophylaxis before and after extraction and other dental surgery.

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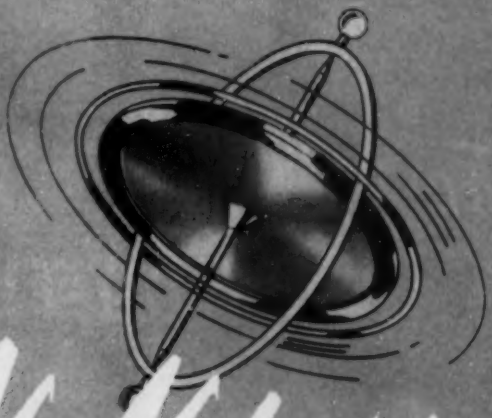

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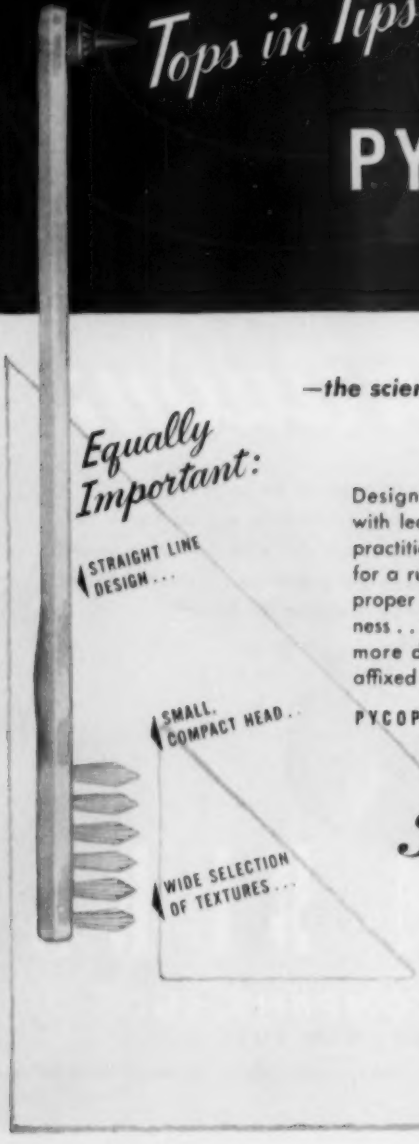

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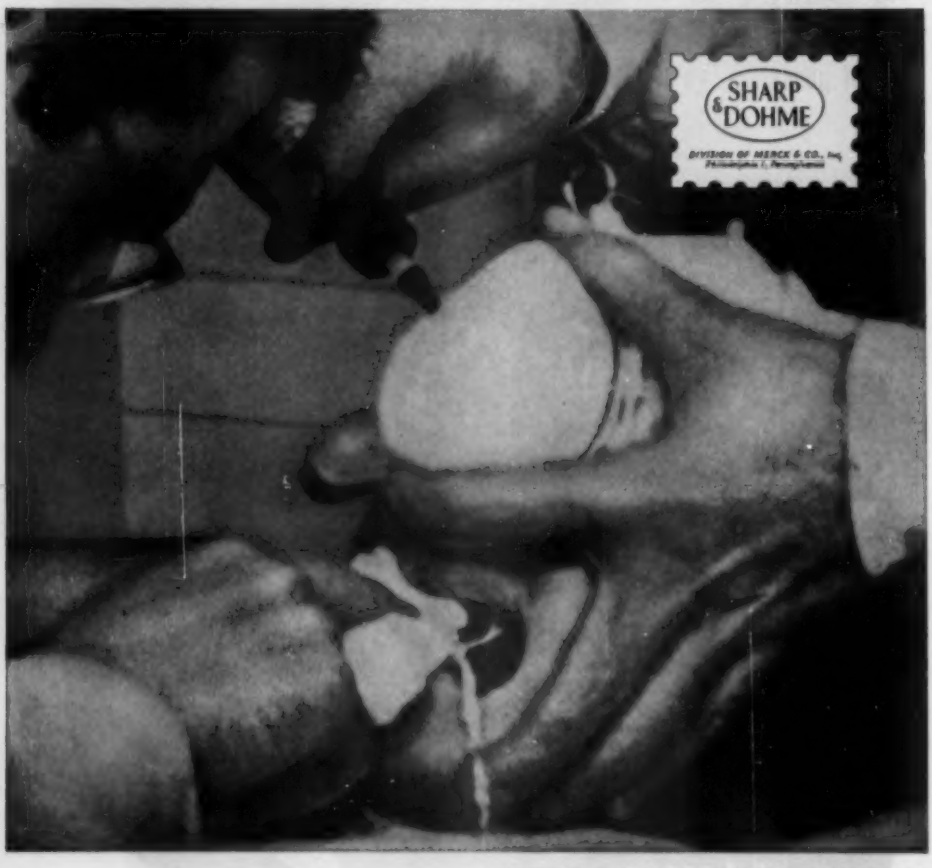

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Welcome oblivion for dental extractions

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ADVANTAGES: VINETHENE offers welcome benefits to both exodontist and patient. It minimizes emotional trauma by inducing anesthesia rapidly and smoothly. Recovery is prompt and usually without postextraction nausea. VINETHENE affords desired flexibility too; it may be administered via the simple open-drop technic or used in your gas machine to complement nitrous oxide-oxygen.

SUPPLIED: In bottles of 25 cc., 50 cc., and 75 cc., each with convenient dropper-caps.

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MORE INSURANCE NOW AVAILABLE
think! HOW THESE AMOUNTS WOULD HELP IN PAYING ESTATE TAXES IN CASE YOU ARE ACCIDENTALLY KILLED . . .
ALSO included in these plans . . . .
EACH month for TOTAL DISABILITY
either from ACCIDENT or SICKNESS
SPECIFIC BENEFITS ALSO FOR LOSS OF SIGHT,

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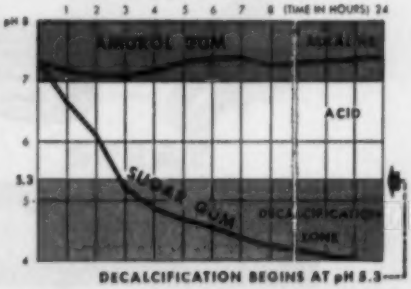
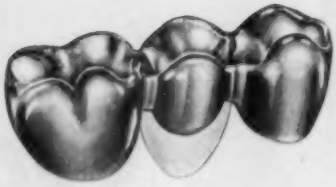
Comparative Effects of Sugar Gum and Amurol Gum on pH of Saliva



DECALCIFICATION BEGINS AT pH 5.3

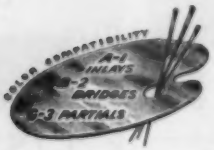
As shown above, pH of caries-active saliva remains in alkaline zone for hours with AMUROL SUGARLESS GUM, whereas with sugar gum the pH drops to the acid level under the same conditions.



A dentist tells us:

"How often we see bridges that look good,
except for the soldered joints. But your Balanced Line
Solder won't tarnish, color-matches
your casting golds, and *just doesn't show.*"

Balanced Line Solder
is available in rod form
another Ney exclusive.



THE J. M. NEY COMPANY
HARTFORD 1, CONN.

why risk these HAZARDOUS TEMPERATURES

created by frictional heat of rotating cutting instruments

The following chart is based on data from a study recently conducted by the School of Dentistry, University of Michigan, Ann Arbor, Mich.*

TYPE BUR	COOLANT	DEGREES F. RISE AT 1 LB. PRESSURE			
		2000 RPM	4000 RPM	6000 RPM	10000 RPM
#37 Steel	None	37°	60°	78°	112°
	Air Only	17°	25°	33°	43°
	Air-Water Spray	4°	7°	9°	12°
#37 Tungsten Carbide	None	26°	42°	57°	84°
	Air Only	17°	25°	33°	45°
	Air-Water Spray	3°	6°	9°	12°
#701 Diamond	None	21°	30°	39°	52°
	Air Only	9°	14°	18°	25°
	Air-Water Spray	2°	4°	7°	9°

* Report Published in New York Journal of Dentistry, 32:147-157 (April) 1952

NOTE: Degrees F. represent temperature rise above initial temperature of operating area. For example, at intermittent operation of 2 seconds cutting and 1 second rest, *without coolant*, a #37 steel bur at 1 lb. pressure and 6000 rpm increases the temperature 78° F. Accepting 90° F. as the initial temperature of the operating area, the cutting operation, therefore, brings the temperature in the tooth structure up to 168° F.

It can be readily seen that, even at minimum operating speeds and pressures, rotating cutting instruments create excessive heat, with needless risk of serious damage to tooth tissue and pain to the patient.

The Hanau Therm • Ex Spray, proved and acclaimed by thousands of users, effectively holds operative temperatures at a safe and tolerable level, *by providing at the tip of the bur an atomized water spray, or air only, as preferred.*

For further information, consult your dealer or write Hanau.

prevent frictional heat with

THERM·EX

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SPRAY

HANAU
ENGINEERING CO., INC.
1233 Main St. Buffalo 9, N. Y.

ASSOCIATION PLAN
Accident and Health Insurance

THIS IS THE ONLY PLAN OF ACCIDENT AND HEALTH INSURANCE ENDORSED OR APPROVED BY THE AMERICAN DENTAL ASSOCIATION

Applications are invited from Association Members who have not yet applied; the coverage is available to applicants in accordance with the Company's rules and regulations for acceptance of risks.

• • • •

BRIEF OUTLINE OF COVERAGE

Accident Benefits —Full monthly benefit for total disability, from FIRST DAY, limit 60 months. **One-half monthly benefit for partial disability, limit 6 months.** Limit of time for total and partial combined 60 months.

Sickness Benefits —Full monthly benefit for total disability commencing with Eighth day of disability, limit 24 months, **house confinement not required.**

Individual Termination —The insurance of each insured member will continue in force concurrently with the group policy and will only be terminated by reason of any of the following conditions:

a. If the group policy is terminated.

b. If the insured member fails to pay the required premium.

c. If the insured member ceases to be a member of the American Dental Association.

d. If the insured member retires or ceases to be actively engaged in the dental profession.

• • • •

PREMIUM RATES

(Applicable to ages at entry and attained at annual renewal date of the group policy, which is November 1 of each calendar year. Renewal rates do not change on attainment of age 65.)

				SEMI-ANNUAL RATES		
Monthly Benefits	Accidental Death Benefit	Dismemberment Benefits	Ages Up To 50	Ages 50 to 60	Ages 60 to 65	Ages** 65 to70
$100.00	$3,000.00	$ 5,000.00	$16.05	$18.30	$22.80	$26.30
$200.00	3,000.00	10,000.00	30.15	34.65	43.65	50.65
$300.00	3,000.00	15,000.00	44.25	51.00	64.50	75.00
$400.00	3,000.00	20,000.00	58.35	67.35	85.35	99.35

Premiums will be billed half-yearly.

**Although the age limit for acceptance of risks is the 70th birthday, once issued, there is no termination age limit for renewal.

If you are not now insured under the ASSOCIATION PLAN, communicate with the Trustee of the Policy Dr. Paul W. Zillmann, 29 Walden Avenue, Buffalo 11, N. Y., or with M. A. Gesner, Inc., 150 East Superior St., Chicago 11, Ill.

• • • •

Issued Exclusively by

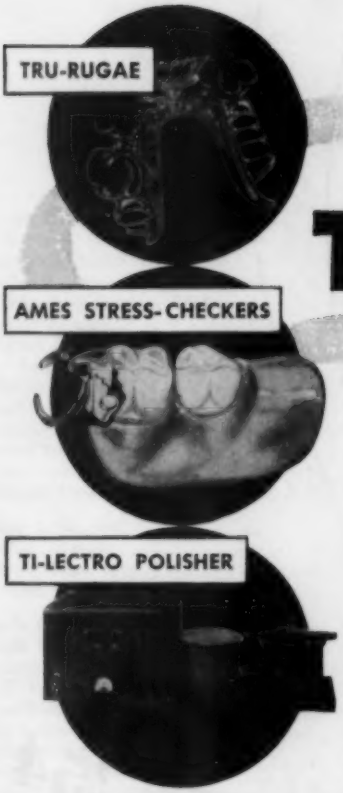
NATIONAL CASUALTY COMPANY of Detroit

Through

M. A. GESNER INC.

150 East Superior Street **WHitehall 3-1525** **Chicago 11, Ill.**

Since the National Casualty Company's plan of accident and health insurance is now in effect in New York, New Jersey, California, Utah and Nevada, the Association Plan is not available in those states.



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FOR THE A.D.A.'S 95TH ANNUAL SESSION, NOV. 8, 9, 10 & 11

Stimulating experiences await you in colorful Miami. There will be all the features of a full-scale scientific session of the American Dental Association . . . . . essays, exhibits, symposia, motion pictures, panel discussions, projected clinics . . . . . reports on all that's new in dentistry, plus fascinating entertainment. Excellent accommodations in leading hotels in both Miami and Miami Beach are available for you at bargain rates. Bring your family for a well-deserved vacation after the meeting. Take your choice of a myriad of activities . . . . . fishing, sight-seeing, boating, golfing, surf bathing, cruising under the stars . . . . . or if you prefer, just relaxing under the sun!

You will long remember the A.D.A. session in Miami!

MAKE RESERVATIONS NOW! (USE OFFICIAL APPLICATION FORM ON PAGE A-291)

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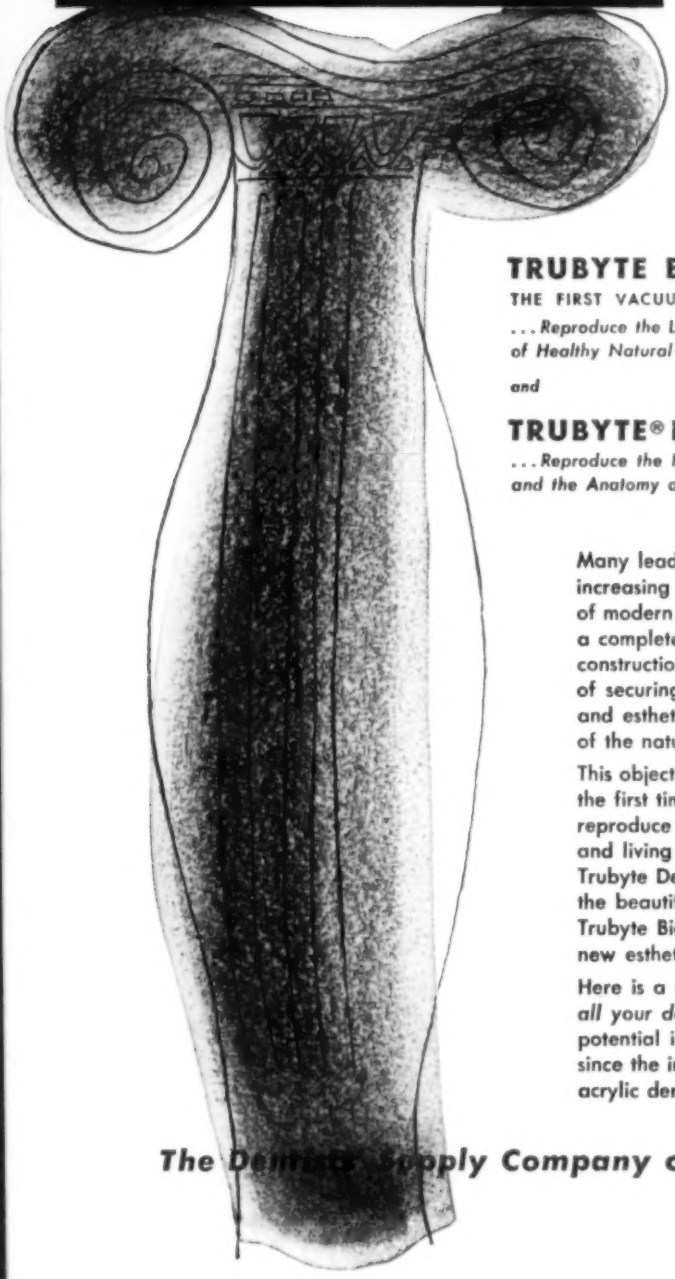
The highest achievement in denture esthetics



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and

TRUBYTE® DENTURE VENEERS

. . . Reproduce the Natural Color of the Living Tissue and the Anatomy of Natural Gum Contours

Many leading authorities agree that the ever increasing cosmetic and esthetic requirements of modern dentistry demand a new evaluation — a completely new concept of denture construction — with the desirable objective of securing in the artificial denture the phonetics and esthetics truly representative of the natural dentition.

This objective can now be realized. Now, for the first time, it is possible to easily and quickly reproduce the natural anatomical contour and living tissue color in the artificial denture. Trubyte Denture Veneers, in combination with the beautiful natural forms and shades of Trubyte Bioform Teeth, open the way to a vast new esthetic denture service.

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